SCIENCE ABSTRACTS.

Section A.—PHYSICS.

FEBRUARY 1905.

GENERAL PHYSICS.

328. *Flow of Solids, especially of Ice, under High Pressures.* **A. v. Obermayer.** (Akad. Wiss. Wien, Sitz. Ber. 113. 2a. pp. 511–566, March and April, 1904.)—The pressure required to produce a flow of ice depends on the diameter of the orifice, but the pressure decreases less rapidly than the diameter increases, as is shown by the following table :—

$d = 1{\cdot}00$ cm.	$Q_m = 7{,}500$ kg.	$Q_m \times d = 7{,}500$
1·50	7,000	10,500
2·00	6,400	12,800
3·10	4,800	14,880
4·10	4,000	16,400
6·10	3,000	18,300
10·00	1,800	18,000

The velocity of flow increases rapidly when the pressure is increased beyond these values ; thus, with 1 cm. orifice—

$Q_m = 7{,}500$	8,000	9,000 kg.
$v = 4{\cdot}4$	6·5	31·8 cm./min.

In each case Q_m represents the readings of the manometer in kg. ; the actual pressures in kg. per sq. cm. to which the ice was submitted were about one-fifth as great. Similar experiments are described with paraffin wax, pitch, yellow wax, ceresin, camphor, and lead. T. M. L.

329. *Deformation of Cylindrical Elastic Plates of Arbitrary Dimensions.* **T. Boggio.** (Accad. Lincei, Atti, 13. pp. 419–427, Nov. 20, 1904.)—This paper refers to a theorem given by Clebsch (Theorie de l'elasticité des corps solides, Paris, 1883), in which that writer seeks to determine the state of equilibrium of a cylindrical plate of finite dimensions, when on the curved surface there act forces parallel to the base, symmetrical with respect to the middle section parallel to the base, which tend to produce elongation and contraction, without torsion or flexure. The solution of this problem as given by Clebsch consists in finding two functions, ϕ, ψ, which he succeeded in determining, for circular plates only, by recourse to a series, which makes the work complicated. It is necessary to set out the equations given by Clebsch for ϕ, ψ. They are in the interior—

$$\frac{\partial^2\phi}{\partial x^2}+\frac{1-\kappa}{2}\frac{\partial^2\phi}{\partial y^2}+\frac{1+\kappa}{2}\frac{\partial^2\psi}{\partial x\partial y}=0.$$

$$(1)\qquad \frac{\partial^2\psi}{\partial y^2}+\frac{1-\kappa}{2}\frac{\partial^2\psi}{\partial x^2}+\frac{1+\kappa}{2}\frac{\partial^2\phi}{\partial x dy}=0,$$

and at the limits—

$$\left\{\left(\frac{\partial\phi}{\partial x}+\kappa\frac{\partial\psi}{\partial y}\right)+a\left(\frac{\partial^3\phi}{\partial x^3}+\kappa\frac{\partial^3\psi}{\partial x^2\partial y}\right)\right\}\frac{\partial x}{\partial n}$$
$$+\left\{\frac{1-\kappa}{2}\left(\frac{\partial\phi}{\partial y}+\frac{\partial\psi}{\partial x}\right)+a\left(\frac{\partial^3\phi}{\partial x^2\partial y}+\frac{\partial^3\psi}{\partial x\partial y^2}\right)\right\}\frac{\partial y}{\partial n}=\Phi$$

$$\left\{\frac{1-\kappa}{2}\left(\frac{\partial\phi}{\partial y}+\frac{\partial\psi}{\partial x}\right)+a\left(\frac{\partial^3\phi}{\partial x^2\partial y}+\frac{\partial^3\psi}{\partial x\partial y^2}\right)\right\}\frac{\partial x}{\partial n}$$
$$+\left\{\left(\kappa\frac{\partial\phi}{\partial x}+\frac{\partial\psi}{\partial y}\right)+a\left(\frac{\partial^3\phi}{\partial x\partial y^2}+\frac{\partial^3\psi}{\partial y^3}\right)\right\}\frac{\partial y}{\partial n}=\Psi,$$

in which ∂n is an element of the normal, κ is a constant depending on the nature of the plate, and $a=\frac{kh^2}{4}$, where h is the height of the cylinder. Also Φ, Ψ satisfy the equations $\int_s\phi\partial s=0$, $\int_s\Psi\partial s=0$, $\int_s(y\Phi-x\psi)\partial s=0$, $\int_s$ denoting integration round the circumference s of a section parallel to the base. The last three equations express the equilibrium of the forces. The simplification adopted in this paper by the author consists in introducing three new functions: $T_{11}=\frac{\partial\phi}{\partial x}+\kappa\frac{\partial\psi}{\partial y}$, $T_{12}=\frac{1-\kappa}{2}\left(\frac{\partial\phi}{\partial y}+\frac{\partial\psi}{\partial x}\right)$, $T_{22}=\kappa\frac{\partial\phi}{\partial x}+\frac{\partial\psi}{\partial y}$, and therefore $T=T_{11}+T_{22}=(1+\kappa)\left(\frac{\partial\phi}{\partial x}+\frac{\partial\psi}{\partial y}\right)$, whence he proves that T is a biharmonic function, *i.e.*, satisfies $\Delta^2T=\left(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\right)T=0$—

$$T_{11}=\frac{\partial^2U}{\partial y^2},\quad T_{22}=\frac{\partial^2U}{\partial x^2},\quad T_{12}=-\frac{\partial^2U}{\partial x\partial y},$$

in which U is an arbitrary function. Therefore also U is a biharmonic. Also if $V=U-\frac{a}{1+\kappa}T$, it is shown that V is biharmonic. And further that, if we assume that at a certain point P_0 in the boundary $\partial V/\partial x-0$, and $\partial V/\partial y=0$, then at every other point P in the boundary—

$$\frac{\partial V}{\partial y}=\int_{P_0}^{P}\Phi\partial s\qquad \frac{\partial V}{\partial x}=-\int_{P_0}^{P}\Psi\partial s$$

and—

$$\frac{dV}{dn}=\frac{dx}{dn}\frac{\partial V}{\partial y}+\frac{dy}{dn}\frac{\partial V}{\partial x}.$$

These equations are shown to determine V and dV/dn at every point in the boundary, and, since V is biharmonic, at every point in the interior. It has been found, the author says, for various classes of areas, including circular areas. V being thus determined, T is determined from $T=\Delta^2V$. The author then proceeds to determine the functions ϕ, ψ. This he does in the form

$\phi = W_1 - \omega y + c_1 \quad \psi = W_2 + \omega x + c_2$, in which W_1, W_2 are known functions of position, and c_1, c_2, and also ω, are arbitrary constants. These formulæ are solutions of the problem. He points out that the case of an elastic, isotropic, plane, infinitely thin plate, on the boundary of which act forces in its plane, whose components are denoted by Φ, Ψ, where problem is to determine the displacements when the system is in equilibrium, is a particular case of the above. It was treated by Clebsch for a circular plate by his method of series. Finally he refers to another problem discussed by Clebsch, namely, the deformation of cylinders, which depends on the determination of two functions u, v, which at points in a right section satisfy the equations—

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} = 0 \qquad \frac{\partial u}{\partial y} - \frac{\partial v}{\partial x} = 0$$

and on the boundary $u\frac{dx}{dn} + v\frac{dy}{dn} = \Phi$, Φ being a known function satisfying—

$$\Phi = N - \frac{1}{2A}\left(x\frac{dx}{dn} + y\frac{dy}{dn}\right)\int_s N\,ds,$$

where N is given at all points of the boundary s, and A is the area of the section. This was solved by Clebsch in a series, for circular areas. The writer shows that u, v can be found easily by solving Dirichlet's problem for the circular area.
S. H. B.

330. *The Secondary Oscillations of Oceanic Tides.* **K. Honda, Y. Yoshida, and T. Terada.** (Mathematical and Physical Soc., Tokyo, 2. 16. pp. 222–282, 1904.)—On behalf of the Earthquake Investigation Committee the authors have made observations at twenty-six bays and stations of Japan with the aid of a modified Nakamura tide gauge [see Abstract No. 1320 (1903)], and of a modified Richard hydrometer; the latter answered better when the apparatus had to be set up at some height above the water-level. The paper also discusses Imamura's observations at ten stations, and the records of Kelvin tide gauges from three stations. The secondary undulations proved quite inconspicuous and irregular on the Pacific coast at points where there are no inlets; conspicuous, but not regular, on the open coast of the Japan Sea at points without inlets; not conspicuous in bays of considerable area or shallow bays with narrow inlets; most pronounced in deep bays or estuaries, gradually diminishing in breadth from the sea inward; the phases of the prominent undulations are the same at different points of a bay, and common undulations are observed in bays or open coasts not far removed from one another; the principal undulation frequently changes its period continuously or abruptly; the period of the prominent undulation is approximately given by $T = 4L/\sqrt{hg}$, where L and h are the length and depth of the bay. The authors believe that the secondary undulations are not seiches, but due to the long waves from the sea, to which the bays respond like resonators. The formula would give the period of a uninodal tank oscillation with a node at the mouth and a loop at the end of the bay. The calculated values agree well with the observed periods; trinodal, pentanodal, &c., oscillations have also been observed. Omori had noticed that the tsunamis (the destructive earthquake sea-waves) of the Ayukawa mareograms showed the ordinary secondary oscillations; the authors suggest that waves generated in certain portions of the open sea have definite periods, in whatever way the water be disturbed.
H. B.

331. *The Geyser in Atami.* **K. Honda** and **T. Terada.** (Mathematical and Physical Soc., Tokyo, 2. 13. pp. 164–172, 1904.)—The geyser projects hot water and steam alternately, five or six times in succession; the period of activity as a rule lasts 2 hours, and is followed by a period of repose lasting 3 hours, so that five eruptions follow one another in the course of a day. The water does not return to the mouth, being discharged through three openings in a nearly horizontal direction. Originally the funnel was vertical, but the mouth has been stopped, and some of the hot water is utilised. The authors fixed up instruments to determine the pressure, flow, and velocity of the water and steam, the temperature, which rises to 112° C., the level changes, &c. About 45 cub. m. of water are discharged during an eruption. A high barometer accelerates the eruption, a low barometer retards it; the quantity discharged is greater at low barometer. From their own observations and those of Tawara, the authors conclude that a subterranean cavity—filled partly with sea-water from Atami Bay, as the water discharged contains 0·5 per cent. of sodium chloride—communicates with the surface by a pipe which receives a tributary of cooler water. The periods depend upon the differences in the temperatures of the water in the cavity and in the tributary. A model of this kind worked satisfactorily. A list of papers, dealing with the explanation of geyser phenomena, is given. H. B.

REFERENCES.

332. *Muscular Energy. Flexors and Extensors. Discontinuity of Work.* **A. Chauveau.** (Comptes Rendus, 139. pp. 525–531, Oct. 3, and pp. 557–562, Oct. 10, 1904.)—Continuing his experiments [see Abstracts Nos. 2134 and 2493 (1904)], the author finds that under the same conditions the extensor of the forearm does 0·6 and the flexor 0·4 of the work. In doing work the muscles may be in continuous, alternating, or in discontinuous contraction. In order to economise the expenditure of energy required to start the muscles we should make few movements of long range. H. B.

333. *Available Muscular Energy, Frequency of Contractions, and Load.* **C. Henry** and **J. Ioteyko.** (Comptes Rendus, 139. pp. 876–879, Nov. 21, 1904.)—The authors deduce an approximate formula for the ratio of the available energy Ev to the work done $\mathfrak{T}$: $Ev/\mathfrak{T} = \{0·95 + 18·9/(n + 40)\}\sqrt{1 + 0·0207p^2}$, where p is the load, and n the number of contractions [see Abstract No. 1609 (1904)]. For $p = 5$ kg., and $n = 90$, this ratio is 1·34; for very small loads and very frequent contractions, the two terms differ little from one another. H. B.

334. *Heights of Perseid Meteors of* 1904. **V. Fournier, A. Chaudot,** and **G. Fournier.** (Comptes Rendus, 139. pp. 960–962, Dec. 5, 1904.)—Observations were made on August 9, 10, 11, 12, 13, and 16, 1904, at Rouvray (Côte-d'Or), 274 trails being registered, of which 180 were afterwards found to be Perseids. The position of the principal radiant was found to be RA = 3 hours 25 min.; Decl. = + 49, and a number of secondary radiants are tabulated. Special observations were made at the two stations of Rouvray and Dompierre en Morvan for the determination of the heights of meteors. The places were 10·100 km. apart, and 13 trails were observed from both stations simultaneously. These were reduced by Chrétien's method, and the resulting heights above the ground are tabulated. The mean height of apparition is given as 168·5 km., and of disappearance, 53·3 km., with a mean length of trajectory of 145·2 km. C. P. B.

LIGHT.

335. *Practical Performance of Tri-colour Filters.* **A. J. Newton** and **A. J. Bull.** (Photographic Journ. 44. pp. 263–271; Discussion, pp. 271–273, Oct., 1904.)—A record of tests carried out with twelve different sets of filters, viz., those of Ives, Sanger, Shepherd, Lumière, Farmer and Symmons, Klein, with others made at Bolt Court, reproductions being made by the various filters of a hand-painted chart in oil colours, possessing great variation of colour and gradation. In order to determine the precise manner in which the filters were acting with regard to the colours being recorded, and the variation in the character of the record when working on light and dark colours, a series of sets of exposures was made to a nearly normal spectrum produced by a prism grating. Coloured prints of the spectra are given showing the performances of the filters. In reply to certain members' criticisms, **A. J. Newton** said it was obvious that ultra-violet had a disturbing and bad effect, as it was not seen when looking at the subject. Bull and he always cut out the ultra-violet except when using a wet plate. Using the new sensitisers they had obtained three negatives with total exposure of under 20 min. with average electric arc lamps. G. E. A.

336. *Relative Motion of Earth and Ether.* **A. A. Michelson.** (Phil. Mag. 8. pp. 716–719, Dec., 1904.)—A method was recently proposed by W. Wien [see Abstract No. 360 (1905)] for deciding the important question of the entrainment of the ether by the earth in its motion through space, by measuring the velocity of light in one direction—that is, without reflecting it from the distant station. The essentials in the proposed method are two Foucault mirrors, or two Fizeau wheels (one at each station), revolving at the same speed. The control for this synchronism is to be furnished by the constancy of the light passing along, or by known stroboscopic methods. The flaw in the proposed method—as pointed out by S. Newcomb in 1880—lies in the fact that the effect to be measured is exactly the same as the effect on the light which is to furnish the test of synchronism. In November, 1887, the present author proposed a method differing in no essential respect from that just criticised, except that the control of synchronism was to be furnished by electrical methods. This was before the work of Hertz showed that electrical waves differed in no essential from light. This identity constitutes the same objection to this plan. The possibility of a mechanical method of control was pointed out in 1902 [see Abstract No. 1508 (1902)], based on experiments which showed that the vibrations of a tuning-fork could be transmitted over a mile of piano-wire with but little diminution of amplitude. The paper then proceeds to discuss the magnitude of the effects due to the earth's rotation and orbital motion if the earth does not entrain the ether. E. H. B.

337. *Refractive Indices of the Elements.* **C. Cuthbertson.** (Roy. Soc., Proc. 74. pp. 283–284, Dec. 10, 1904. Abstract.)—Attention was previously drawn by the author to the fact that the refractivities of the five new inert gases of the atmosphere are in the proportion of 1, 2, 8, 12, and 20, or, more simply, of ¼, ½, 2, 3, and 5; similarly also the refractivities of the three

halogens, chlorine, bromine, and iodine stand also in the relation of 2, 3, and 5. In the present paper results are given for mercury, phosphorus, and sulphur, and it is shown that the simple relations existing in the case of the inert gases and the halogens also hold good for nitrogen and phosphorus, and for oxygen and sulphur; the refractivities of phosphorus and sulphur are four times as large as those of nitrogen and oxygen respectively. Twelve elements, therefore, have been shown to conform to the rule that in each chemical group the refractivities are in the ratio of small integers. Mercury and hydrogen have no allied elements with which they can be compared. Attempts have been made to measure the refractivity of fluorine, but the experiments have not yet been perfectly successful. It is very interesting to note that as the refractivities of phosphorus, sulphur, and argon are respectively four times those of nitrogen, oxygen, and neon, we may consider the two series, nitrogen, oxygen, fluorine and neon, and phosphorus, sulphur, chlorine, and argon, as, in some sense, homologous. Further, on comparison of the values for the last series, the power to retard light appears to be closely connected with the valency and not with the atomic weight. Thus—

	P.	S.	Cl.	A.
Atomic weight........	31	32	35·5	40
Refractivity	299 × 4	275 × 4	192·4	141 × 4

Neon, oxygen, and nitrogen show the same relation. E. C. C. B.

338. *Relative Motion of Earth and Ether.* **E. W. Morley** and **D. C. Miller.** (Phil. Mag. 8. pp. 753–754, Dec., 1904.)—To explain the result of the experiments of Michelson and Morley in 1887, it was suggested by FitzGerald and Lorentz that the stone slab on which the apparatus was constructed might have its dimensions changed by its drift through the ether. If this effect exists it may affect all materials equally or it may affect them to varying amounts dependent on the nature of the materials. With a view to finding, if possible, any such change of behaviour, a structure of pine has now been made and floated on mercury, like that used in 1887. Experiments with the new apparatus were carried out in July, the effect to be expected (on the original theory) being 1·4 wave-lengths. It was established that the effect, if any, is not more than 0·015 wave-length. E. H. B.

339. *Radiation Pressure.* **J. H. Poynting.** (Nature, 71. pp. 200–201, Dec. 29, 1904.)—In a previous article [see Abstract No. 2926 (1904)] it was calculated that there is on the earth as it moves in its orbit a retarding force due to radiation pressure amounting in all to about 20 kg. The calculation was made on the supposition that the earth is a full radiator of uniform temperature. On revision it appears the value should be 2,500 kg. But another effect comes in which will more than counterbalance this. The hemisphere of the earth which is advancing in the orbit is on the whole colder than that which is retreating, owing to the lag in the warming of the surface exposed to the sun. If one hemisphere is at 301° A., and the other at 300° A., the greater radiation from the warmer side gives a net push directed from that side to the colder of about 165,000 kg. It is further calculated that particles whose radii are of the order 10^{-5}, falling in a vacuum between walls respectively 27° C. and 127° C., would not fall vertically, but would deviate 2 mm. per metre towards the colder wall. [See also Abstract No. 1082 (1904).] E. H. B.

340. *Relation of Position Isomerism to Optical Activity.* II. *Rotation of Menthyl Esters of Isomeric Chlorobromobenzoic Acids.* **J. B. Cohen** and **H. S. Raper.** (Chem. Soc., Journ. 85. pp. 1262–1271, Sept., 1904.)—The following table shows the properties of the ten isomeric menthyl chlorobromobenzoates, and indicates that position-isomerism has a large effect on the rotatory power, even though the optically active centres are in the menthyl group, and considerably removed from the benzene nucleus in which the change of position was effected :—

Menthyl Ester of Chlorobromo-benzoic Acid, Cl Br	M.p.	B.p.	Pressure in mm.	Density at 20°.	$[\alpha]_D^{20°}$.	$[M]_D^{20°}$.	$[M]_D^{20°}$ of the Corresponding Menthyl Dichlorobenzoate.
2 : 3	31–32°	237–239°	22	1·2582	−46·18°	−172·5°	−172·9°
3 : 2	—	227–229	14	1·2372	−51·82	−193·5	
2 : 4	—	224–226	18	1·2683	−54·57	−203·9	−209·6
4 : 2	—	221–223	18	1·2723	−58·70	−219·2	
2 : 5	34–35	224	20	1·2764	−50·91	−190·2	−199·4
5 : 2	36·5–37·5	221–222	17	1·2677	−55·68	−207·8	
2 : 6	144–145	not distilled	—	In benzene solution.	− 8·70	− 32·5	−113
3 : 4	46–47	225–227	18	1·2866	−55·67	−207·9	−227·5
4 : 3	35–36	223–225	10	1·2854	−59·15	−220·9	
3 : 5	—	226–228	21	1·2444	−62·90	−235·9	−233·2
Menthyl benzoate (Tschugaeff)	54	—	—	In benzene solution.	−90·92	−236·3	

T. M. L.

341. *Relation of Position Isomerism to Optical Activity.* III. *Rotation of Menthyl Esters of Isomeric Iodobenzoic Acids.* **J. B. Cohen** and **H. S. Raper.** (Chem. Soc., Journ. 85. pp. 1271–1274, Sept., 1904.)—The following table shows the molecular rotations of the menthyl esters of the chloro-, bromo-, and iodo-benzoic acids :—

Menthyl benzoate $[M]_D^{20°} = 236·3°$ (Tschugaeff).

Menthyl Chlorobenzoate (C. and B.).	$[M]_D^{20°}$.	Menthyl Bromobenzoate (Tschugaeff).	$[M]_D^{20°}$.	Menthyl Iodobenzoate (C. and R.).	$[M]_D^{20°}$.
ortho	−195·0°	ortho	−205·3°	ortho	−246°
meta	−236·9	meta	−238·7	meta	−234·5
para	−237·3	para	−238·8	para	−241·2

T. M. L.

342. *Optical Activity of Methyl and Ethyl Esters of Di-*o*-, -*m*-, and -*p*-nitrobenzoyltartaric Acids.* **P. F. Frankland** and **J. Harger.** (Chem. Soc., Journ. 85. pp. 1571–1580, Nov., 1904.)—The rotations of these compounds in the liquid state have been observed over a wide range of temperature, showing that although dimethyl and diethyl tartrates have $[\alpha]_D^{20°} + 2·14°$, and 7·67° respectively, all the dinitrobenzoyltartrates have lævorotations, those of the methyl being greater than those of the ethyl compounds, and while the *p*-isomeride has in each case a higher rotation than the *m*-compound, the relative rotatory value of the *o*-nitrobenzoyl group entirely depends on temperature, at 15° being the highest, and at 180° the lowest of the three. The *m*- and *p*-nitrobenzoyl groups have at all temperatures investigated a greater rotatory effect than that of the benzoyl group at the same temperature, but the effect of the *o*-nitrobenzoyl group is greater or less than the benzoyl according to temperature. The nitrobenzoyl has a higher rotation than the corresponding toluyl compound, excepting in the case of the ethyl *o*-nitro-derivative, which at high temperatures has a less rotation than ethyl di-*o*-toluyl tartrate. The molecular volumes of the ethyl compounds have been determined and found to follow the same order as the rotations, that of the para- being the greatest, and that of the ortho- least. W. H. Si.

343. *Flame Spectra.* **C. de Watteville.** (Roy. Soc., Phil. Trans. 204. pp. 139–168, Nov. 12, 1904. Roy. Soc., Proc. 74. pp. 84–85, Aug. 10, 1904. Abstract.)—An extension of Gouy's work upon the spectra of flames which are coloured by injecting the spray from saline solutions into the gas to be burnt. The investigation was especially concerned with the spectrum of the blue inner cone, wherein Gouy had noticed the appearance of several new lines. The observations given in the paper were obtained with the help of both grating and prism spectrographs, and extended over the visible spectrum well into the ultra-violet. An examination of the different parts of the flame in the case of potassium showed that in the blue cone all the metallic lines could be seen together with the Swan spectrum; above this could be seen the lines of the two secondary series; in the highest portion of the flame only the lines of the principal series. As a general rule the flame spectrum lines are those which are strongest in the arc spectrum, but in certain cases some of the strongest arc lines are absent, while less intense arc lines are visible. None of the characteristic spark lines are ever seen in the flame, but there is considerable resemblance between the latter and the spark spectrum obtained with self-induction; this is specially true in the case of iron, nickel, and cobalt. The author attributes the phenomena entirely to differences of temperature. [See also Abstract No. 1020 (1904).] E. C. C. B.

344. *Infra-red Absorption Spectra of Organic Compounds.* **W. W. Coblentz.** (Astrophys. Journ. 20. pp. 207–223, Oct., 1904.)—Previous studies of infra-red spectra are defective, and often lead to erroneous conclusions, since they do not extend sufficiently far into the infra-red region to show the characteristic bands which often appear only with very large wave-lengths. The author has examined the infra-red spectrum of about 100 liquids or solids and 14 gases, up to 14 μ (using a rock-salt prism), and of 19 liquids up to 2·5 μ (using a quartz prism); the present paper gives a preliminary account of the results. *Effect of structure.*—This was ascertained chiefly by the study of isomeric groups. In the case of thymol and carvacrol, $C_{10}H_{14}O$, a change in the position of the hydroxyl group is accompanied by a marked change in the spectrum at 5 and 6 μ, and an entire rearrangement at 9 to 14 μ. Again, the benzene band at 3·25 μ found in aniline is entirely obliterated by the one found at 3·35 μ in its isomer, picoline, while in the spectrum of picoline only one band, at 10 μ, is in common with one of aniline. In the sulphocyanates R — SCN and the isomeric mustard oils R — NCS the effect of structure is still more pronounced; the mustard oils are unique in having an enormous absorption band in the region of short wave-lengths; the band 4·78 μ is a characteristic

for mustard oils, as is the band from 8 to 8·4 μ for carbohydrates. The benzene compounds show totally distinct infra-red spectra from the chain compounds, so that this evidence alone would be sufficient to differentiate the two classes of bodies. *Effect of molecular weight.*—The results agree with those of Krüss in so far as it seems possible to assume that the occurrence of a certain absorption band in a different place is a real shift. In benzene the maximum occurs at 8·25 μ, and is shifted to 8·3 μ in toluene, to 8·38 μ in the xylenes, and to 8·4 μ in mesitylene; this is the only instance where the shifting (?) is towards the longer wave-lengths. For a shift (?) toward the shorter wave-lengths, the amino derivatives of benzene are the most conspicuous examples. In gases there is a somewhat more definite shifting of the absorption band, being between 8 and 8·5 μ, as shown in the following table:—

Gas.	Maxima.	Minima.
Acetylene	8·08 μ	7·38 μ
Ethylene	8·28	6·98
Ethane	8·39	6·85
Butane	8·42	6·85
Methyl ether	8·45	6·88
Ethyl ether	8·45	7·00
Methane	8·31	7·70

No shifting could be detected amongst compounds like methyl and ethyl iodide, nitrate, cyanide, &c. Twenty-five distillates of petroleum were examined without getting any evidence of shifting. *Effect of certain characteristic groups of atoms.*—Several hydroxy compounds were studied, and it would appear that a band at 2·95 μ is very probably characteristic. Whether the band is due to the (OH) group must remain open. The fatty acids have no band at 2·95 μ. The paper contains a number of further tentative conclusions as to the connection between certain characteristic groups and spectral lines. D. H. J.

345. *Appearance and Spectra of the Electric Discharge.* **E. Goldstein.** (Deutsch. Phys. Gesell., Verh. 6. 21. pp. 315–324, Nov. 15, 1904. Phys. Zeitschr. 6. pp. 14–17, Jan. 1, 1905.)—A cylindrical vacuum tube about 2½–3½ cm. in diam. is filled with nitrogen at a few centimetres pressure. The discharge through the gas is then very narrow, and shows the well-known banded spectrum in the positive column. The whole is now immersed in liquid air, when the positive column gradually increases in diameter and begins to change colour through golden-yellow to a greenish yellow. The spectrum finally only shows the red and yellow bands extending to the green, the blue bands being entirely absent. The author is inclined to consider that this is the true spectrum of nitrogen and that the three bands are due to admixture of some other gases. The time taken for the complete change to take place varies, being less the purer the nitrogen and the stronger the discharge. The apparent reduction of pressure of the gas on immersion in the liquid air is too great to be accounted for by the fall of temperature only. Some more observations are recorded upon the shape of the discharge and the introduction of the spectrum lines of the metal of the electrodes.

E. C. C. B.

346. *Spectral Series and the Atomic Weight of Radium.* **G. Rudorf.** (Zeitschr. Phys. Chem. 50. pp. 100–110, Nov. 18, 1904.)—Kayser and Runge pointed out that for the alkali metals the relation holds good that $d/A^2 = \text{constant}$, where d is the frequency-difference of the pairs of lines and A is the atomic weight. This, however, is not strictly true. Runge and Precht showed that better results can be obtained by the expression $100d/A^n = \text{constant}$, where n is some power, characteristic of each sub-group in the periodic table of the elements. It was by means of this expression that these authors arrived at the value of 258 for the atomic weight of radium as against the value, found chemically, of 225. Runge and Precht suggested that the discrepancy was due to the presence of barium in the radium; the author, however, points out that this would mean that 20 per cent. of barium chloride must have been mixed with the radium salt, which is manifestly absurd. It is clear that some other explanation must be found. The author has calculated the values of $100d/A^2$ for as many series as possible and plotted them against the values of A, and finds that the curves obtained are very similar in shape. Some extremely interesting points are at once noticed from these curves; first, in the case of the three curves of the corresponding triplets in zinc, cadmium, and mercury, and calcium, strontium, and barium, each pair of corresponding curves cut one on another, and at this point magnesium is to be found. Magnesium, therefore, spectroscopically belongs to both of these two families—a fact strikingly in analogy with its chemical properties. Further, also, the sodium-cæsium curve cuts the copper-gold curve at the sodium point. Again, the shape of all the curves shows that, as the higher members of the families are reached, they tend to bend away from the A axis, with the result that if the calcium-radium curve be drawn of similar shape, the atomic weight of radium readily is found to be 225. From an extension of the cæsium-sodium curve the value of $100d/A^2$ for lithium is found to be 1·7, and thence $d = 0{\cdot}84$. Hagenbach, in his work on the lithium spectrum, considered that he had discovered the duplicate character of the lines, and that $d = 5{\cdot}1$. It is probable, therefore, that the lithium pairs have not yet been found. Calculating in the same way, the author finds that for beryllium $d = 3{\cdot}3$, and for scandium $d =$ about 250–300. [See Abstracts Nos. 1360 (1903) and 2552 (1904).] E. C. C. B.

347. *The Group IV Lines of Silicium.* **N. Lockyer** and **F. E. Baxandall.** (Roy. Soc., Proc. 74. pp. 296–298, Dec. 10, 1904.)—Some doubt having been thrown on the fact that these lines ($\lambda = 4089{\cdot}1$, $4096{\cdot}9$, and $4116{\cdot}4$) belong to silicium, the authors give in detail their reasons for including them in the list of lines of this element. Plates are given showing the vacuum-tube spectrum of silicon tetrafluoride and of the spark spectrum of sodium silicofluoride, and it is shown that the disputed lines have never been noticed in any of the spectra obtained at Kensington without being accompanied by silicium lines of other groups, and unless silicium in some form or other is used in the light source. The wave-lengths of these lines, as well as those of the neighbouring oxygen triplet, agree exactly with very strong lines in the spectra of the belt stars of Orion, and with less conspicuous lines in many other stellar spectra. E. C. C. B.

348. *Fluorescence of Sodium Vapour.* **L. Puccianti.** (Accad. Lincei, Atti, 13. pp. 433–440, Nov. 20, 1904.)—Wiedemann and Schmidt studied the fluorescence of sodium vapour as follows: A piece of sodium was placed in a flask, which was then exhausted and sealed off; by heating the sodium was converted into vapour, and a cone of sunlight was then thrown on to the vapour by means of a lens. The vapour thus showed a beautiful green fluorescence which, when examined with a spectroscope, was found to exhibit a broad channeled green band, a red band, and the D line. The author confirms these conclusions, especially as regards the D line, which he proves to belong with certainty to the fluorescent light, and resolvable into the D_1 D_2 lines. He shows further that it is the D_1 D_2 vibrations of the original light which give the D_1 D_2 lines of the excited fluorescent light together with certain secondary vibrations. The author generalises the results from the point of view given by Rayleigh's theory of resonance with production of secondary waves. D. H. J.

349. *Action of very Low Temperatures on the Phosphorescence of Certain Sulphides.* **F.-P. Le Roux.** (Comptes Rendus, 140. pp. 84–85, Jan. 9, 1905.)—The author has repeated the experiments of Henry on the effect of low temperatures on phosphorescence, extending the range of temperature down to that of liquid air (Comptes Rendus, 122. p. 662, 1896). The calcium sulphide was of the clear blue variety, and in sealed glass tubes. After exciting one tube by means of magnesium light, on plunging it into the liquid air the phosphorescence completely disappeared, to reappear some seconds after removing the tube from the liquid air, the intensity increasing to a maximum when the tube reached the surrounding temperature. A further experiment consisted in plunging a tube of sulphide, rendered inactive by keeping in the dark, into liquid air in a dark room. The whole arrangement was then brought into the light and exposed, with a control tube, to the magnesium light. On being put back in the dark room the tube in the liquid air manifested no luminosity, but it became luminous, as before, shortly after removal from the bath. The author concludes that the maximum potential luminous energy which an activating light can induce in a phosphorescent body is independent of the temperature. What the temperature does is to influence the speed of the transformation of such potential energy into actual luminous energy. L. H. W.

350. *Radio-active and Actinic Properties of Calcined Coral.* **G. Séguy.** (Comptes Rendus, 140. pp. 83–84, Jan. 9, 1905.)—In the course of his experiments upon the phosphorescence of minerals and gases exposed to kathode rays in a vacuum and on the comparative value of these different luminescences and phosphorescences from the actinic point of view, the author was led to expose for equal periods a number of photographic plates of the same emulsion to the influence of radiations of different origin. The results are given in a table, and the author does not for the moment give any explanation. The chief point is the intense photographic action possessed by the calcined coral experimented with. This produced by far the most intense effect, exceeding that of other lights visually brighter. The phosphorescent coral was able to make a platino-cyanide screen fluoresce. L. H. W.

351. *Secondary Radiation Produced by Action on Metals of Kathode Rays from Radium.* **F. Paschen.** (Phys. Zeitschr. 5. pp. 503–504, Aug. 15; and pp. 563–568, Sept. 15, 1904.)—The β- and γ-rays from radium salts produce a secondary radiation when they fall on metals. This can be shown by placing a piece of platinum-foil under or over a photographic plate covered with black paper and exposed to the radiation from a glass vessel containing the radium salt. The secondary radiation produces the largest effect when the platinum is placed below the photographic plate, as in the other case it has to penetrate the platinum-foil which produces it and is thereby largely absorbed. The effects produced by the different rays were determined by spreading them into a spectrum by means of a magnetic field and placing the platinum-foil in the path of the deviated rays; the amount of secondary radiation is greatest in the case of the least deviated (high velocity) β- and γ-rays. The effect now described is regarded as the Röntgen-ray effect produced by the stoppage of the kathode rays, and the fact that the γ-rays produce a maximum effect is regarded as evidence in favour of the author's view that the γ-rays are simply β-rays of high velocity. The second paper contains an account of experiments and calculations bearing out this view.

T. M. L.

352. *Secondary Radiation due to the γ-Rays of Radium.* **A. S. Eve.** (Nature, 70. p. 454, Sept. 8, 1904.)—Recently Paschen described experiments showing that a thick lead block containing radium emits negatively electrified particles which can be deviated in a magnetic field [see Abstracts Nos. 2889 and 2891 (1904)]. He concluded that he had deflected the γ-rays, thus differing from previous experimenters. The present note by Eve explains that the effect which Paschen observed was due not to the primary γ-rays, but to the diffuse secondary radiation caused by the γ-rays in the lead. This is mainly a surface effect, for the secondary radiation from a greater depth than 1 or 2 mm. is absorbed by the lead itself. [See also Abstract No. 354 (1905).]

J. J. S.

353. *Succession of Changes in Radio-active Bodies.* **E. Rutherford.** (Roy. Soc., Phil. Trans. 204. pp. 169–219, Nov. 29, 1904. Bakerian Lecture.)—On account of the large number of active products which are successively formed from the various radio-elements, the question of nomenclature is first considered. Radium gives an emanation, and from this there arise at least five other products, which are named radium A, radium B, &c.; the radium A being the parent of radium B, &c. A similar system is used for thorium and actinium, with the difference that the emanations arise, not directly from the radio-elements, but from intermediate products, Th X or Actinium X. If each substance decays according to the law expressed by $N = N_0 e^{-\lambda t}$, then the relative ionisations after a time t for any length of exposure to the emanation is worked out for the products A, B, C. In the case of uranium Ur X gives rise directly to the final product. The theoretical curves for a long and a short exposure are compared with those obtained experimentally, and are found to agree very closely. For thorium the theory requires two changes, the first a rayless one, the second causes the emission of α-, β-, and γ-rays. The curves give the values of the λ's, but are insufficient to determine which is λ_1 and which λ_2. Two observers, Pegram and v. Lerch, have isolated, by electrolysis, products which decay to half value in about 1 hour. It can thus be calculated that $\lambda_1 = 1{\cdot}75 \times 10^{-5}$ and $\lambda_2 = 2{\cdot}08 \times 10^{-4}$. In the case of actinium Miss Brooks has obtained, by the electrolytic method, a substance for which $\lambda = 7{\cdot}7 \times 10^{-3}$, and by an analysis similar to that used for thorium this is shown to be λ_2, while $\lambda_1 = 2{\cdot}80 \times 10^{-4}$. For radium the rates of decay are found both from the α-rays and the β-rays; the γ-rays always giving results similar to those obtained with β-rays alone. The investigation proceeds on the same lines, and it is found that the facts are explained on the suppositions that radium A has a decay constant

$\lambda_1 = 3{\cdot}8 \times 10^{-3}$, and in the transformation gives rise to α-rays; for radium B, $\lambda_2 = 3{\cdot}10 \times 10^{-4}$ and it is a rayless change; for radium C, $\lambda_3 = 4{\cdot}13 \times 10^{-4}$, and the change to radium D causes the emission of α-, β-, and γ-rays. [Two further changes have since been discovered, see Abstract No. 81 (1905).] Curie and Danne have separated C from B by heating, so that there is no difficulty here in deciding which is λ_2 and which λ_3. In this case it is not altogether certain whether A is the parent of B, or whether they arise independently of each other. A table is given showing the various physical and chemical properties of the separate substances derived from each active element as far as they are known. It is noteworthy that α-rays appear in all the changes except those which are rayless, while β- and γ-rays only appear in the final stages. It therefore appears probable that the β particle, which is finally expelled, may be regarded as the active agent in promoting the disintegration of the atom in the successive stages. It is also possible that closer investigation will lead to the separation of a number of radio-active products, present in a small proportion among the main products we already know. It is pointed out that although the expelled α-rays may be helium atoms, there is still left a heavy atom. There is therefore no evidence in support of the conclusion that helium is the final transformation product of radium. The author has made an unsuccessful attempt to determine directly the charge carried by the α-rays, with the object of using the result to calculate the number of radium atoms which break up each second. The latter may be deduced from the heating effect, for knowing e/m and v and assuming $e = 3{\cdot}4 \times 10^{-10}$ electrostatic unit, $\frac{1}{2} mv^2 = \frac{1}{2} m/e . v^2 . e = 6 \times 10^{-6}$ erg. This is spent on bombarding the radium salt, and generates heat whose mechanical equivalent has been found to be $1{\cdot}2 \times 10^6$ ergs per sec. Hence 2×10^{11} particles per sec. must be expelled per gm. No definite evidence is yet forthcoming that radium is produced by uranium or thorium. R. S. W.

354. *Secondary Radiation caused by the β- and γ-Rays of Radium.* **A. S. Eve.** (Phil. Mag. 8. pp. 669–685, Dec., 1904.)—The secondary radiation from various substances follows approximately the same order as their densities. The coefficients of absorption of secondary radiation by various substances also follow roughly that order. Good radiators are therefore good absorbers. Neither the secondary radiations nor the coefficients of absorption are proportional to the densities. The secondary radiation does not come from the surface merely, but from a total depth varying from about 1·5 mm. in the case of lead to about 3 mm. for glass, aluminium, or paper. It is mainly independent of the state of the surface. Almost the same amount of radiation is obtained from solid iron as from iron filings; from liquid and from solid paraffin; from ice and water; from paper, millboard, papier-mâché, mahogany, pine, and basswood. The theory which agrees most nearly with the results is that the secondary radiation set up in a thin layer is proportional to the density and to the rate of absorption of the primary rays. In one series of experiments it was found that the β-rays caused about 85 per cent. of the secondary radiation and the γ-rays 15 per cent. In the second part of the paper magnetic effects are discussed and reference is made to the results of various observers. It is noteworthy that β, γ, and Röntgen rays all give rise to a secondary radiation consisting of moving particles having a negative charge. The observations of Paschen already discussed in a previous note [see Abstract No. 352 (1905)] are referred to. There is at present no evidence that γ-rays consist of negatively charged particles, and theoretical reasoning still supports the view that the expulsion of β particles is accompanied by pulses similar to those set up on the stoppage of the kathode particles, and it is probable that these pulses analogous to the Röntgen rays constitute the γ-rays. J. J. S.

355. *Absorption and Classification of α-Rays.* **W. H. Bragg.** (Phil. Mag. 8. pp. 719–725, Dec., 1904.)—It is supposed that the absorption of β-rays arises from two causes: (1) Through expenditure of energy on ionisation; (2) through deflections due to collisions. For the α-rays, on the other hand, the first effect is the only one that is supposed to operate. This hypothesis explains the diffusion of Lenard rays in air, while a stream of α-rays is as sharply defined after traversing a thin plate as before. Also α-rays emitted at a certain speed should reach a certain distance from the origin proportional to the initial energy; so that an ionisation chamber should be unaffected if just out of range and much affected if just within it, as Mme. Curie found. A thin cone of α-rays is allowed to traverse a distance h and then enter an ionisation chamber of depth b. If a is their range in air, the ionisation is calculated to be $\frac{nb}{\rho}.(a-h-\frac{b}{2})$ where n and ρ are constants; the ionisation is not supposed to depend on the speed within the limits in which this varies, and the stream is supposed to cross the chamber. If the stream does not cross the chamber, the expression becomes $\frac{n}{2\rho}(a-h)^2$. Hence, if a curve is plotted showing the relation of the ionisation to h, it should be a straight line in the first case and a parabola in the second. Experimentally this is found to be the case. If the stream is made up of three or four sets of rays moving with different velocities, the straight line becomes the sides of a rectilinear polygon, the slope of whose sides alters in arithmetic progression. This also is found to be the case approximately. It is therefore concluded that each transformation in radium that produces α-rays expels them with a different velocity, and four such sets can be recognised. R. S. W.

356. *On Vegetable Radio-activity.* **P. Becquerel.** (Comptes Rendus, 140. pp. 54–56, Jan. 2, 1905.)—The author, suspecting that the so-called bio-radioactivity which Tommasina had noted [see Abstract No. 3207 (1904)], was due to transpiration of the vegetables, describes experiments with an electroscope, which confirm this view. The diminution of the angle between the leaves of the electroscope was 9′ 35″ per hour when the test object within the electroscope was an empty glass, 5° 30′ per hour when the tube contained 1 c.cm. of water, and was reduced again to 9′ 9″ when a piece of caustic baryta was placed by the tube. The hourly diminution was of the same low value when killed, dried and germinating grain, and moss, with baryta near, were tried, and only rose when the desiccating substance was removed. No trace of radio-activity was observable, even after 12 to 16 hours, as long as precautions were taken to prevent the emission of water vapour.

L. H. W.

357. *The Pretended Demonstration of the Existence of the* N-*rays.* **M. Chanoz and M. Perrigot.** (Comptes Rendus, 140. pp. 86–87, Jan. 9, 1905.)—The authors, referring to Bordier's account of the demonstration of the presence of n-rays by the larger halo produced upon a photographic plate exposed to drops of collodion mixed with sulphide [see Abstract No. 84

(1905)], describe some experiments which tend to show that if halos are going to be produced at all, a few seconds' exposure will suffice, and that for screens differing only in the thickness of the sulphide layer, the diam. of the halo depends upon the thickness of such layer. They conclude that if with identical screens, identical halos are produced, the explanation should be sought, not in the different nature of the weights placed upon them, but in the way in which contact between the screens and the plate is established.
L. H. W.

REFERENCES.

358. *Periscopic Lenses.* **W. A. Dixey.** (British Optical Journ. 4. pp. 88–90, Dec., 1904. Paper read before the Optical Society.)—It is discussed how best to adjust the curves of a spectacle lens so that the marginal parts of the lens may be of greatest service. The error caused by spherical aberration is so insignificant that it may be neglected. The effect of radial astigmatism may be partly corrected by means of lenses made on Wollaston's principle. [See also Abstract No. 660 (1902).]
G. E. A.

359. *Simple Photographic Method of Reproducing Pictures.* **C. E. Fairman.** (Scientific American, 91. p. 411, Dec. 10, 1904.)—The picture, manuscript, or drawing to be reproduced is first rendered translucent by being drawn through a dish of melted paraffin. A negative can then be made on printing paper by exposing the translucent picture in a printing frame. After fixing the negative it can be treated with melted paraffin, and from it any number of positives can be printed. G. E. A.

360. *Suggested Experiment to Settle if the Ether Moves with the Earth.* **W. Wien.** (Phys. Zeitschr. 5. pp. 585–586, Oct. 1, 1904. Écl. Électr. 41. pp. 379–380, Dec. 3, 1904.)—The author here suggests that the speed of light be measured by the method of Foucault or that of Fizeau, first in the direction of the earth's motion and then in the opposite direction. He foresees, however, that it would be difficult to attain to an accuracy of observation of the order of the effect to be detected.
E. H. B.

361. *Rare Earth Similar to Gadolinium.* **G. Urbain.** (Comptes Rendus, 139. pp. 736–738, Nov. 7, 1904.)—Lecoq de Boisbaudran had noticed in 1895 that in certain rare earths containing dysprosium a weak absorption band at $\lambda = 488$ was to be seen, which he attributed to a new element. The author has succeeded in fractionating out a salt with a brown oxide, and which gives only the above absorption band; he hopes that it will prove to be a single new element. E. C. C. B.

362. *New Element Zδ.* **L. de Boisbaudran.** (Comptes Rendus, 139. pp. 1015–1016, Dec. 12, 1904. Extract.)—This note is in reply to a criticism by Urbain [see preceding Abstract] of the conclusion that the substance giving an absorption band at λ4877, named Zδ by Boisbaudran, was a distinctive element from dysprosium. Urbain finds the band in the spectrum of other rare earths, and considers that from its relative low intensity it may be only a constituent of the spectrum of the chief element. Boisbaudran does not accept this view, and from the behaviour of an earth giving only the spectra of Dy and Zδ considers the two are different.
C. P. B.

363. *Radio-activity of Rocks in the Neighbourhood of Rome.* **G. Martinelli.** (Accad. Lincei, Atti, 13. pp. 441–444, Nov. 20, 1904.)—The results of numerous experiments are given, together with a description of the specimens and the locality from which they are taken. The tufas and lavas all have decided radio-activity, but he deposits of sedimentary origin have little or none. S. G. S.

364. *Secondary Radiation Produced by Radio-active Substances.* **H. Becquerel.** (Phys. Zeitschr. 5. pp. 561–563, Sept. 15, 1904. Translated from the French.)—The author points out that the paper by F. Paschen [see Abstract No. 351 (1905)] on secondary radiation due to radium contains an account of phenomena already fully described by himself in various papers during the last few years with which Paschen appears to have been unacquainted. J. J. S.

365. *Chemical Composition of the Radio-active Gases from Hot Springs and the Presence of Helium.* **C. Moureu.** (Comptes Rendus, 139. pp. 852–855, Nov. 21, 1904.)—The results of the analysis of the radio-active gases from various hot springs are given, and it is shown that helium is contained in the mixture in every case as well as argon. The quantity of helium and argon varied from 0·5 to 2·06 per cent., but no measurements were made of the relative quantities of these two gases.

E. C. C. B.

366. *Radio-active Emanation of Gastein Waters.* **H. Mache.** (Phys. Zeitschr. 5. pp. 441–444, Aug. 1, 1904. Extract in Anzeiger, Akad. Wiss. Wien, June 23, 1904. II. Phys. Institut d. Universität, Wien.) — The emanation of the waters of Gastein was obtained by bubbling air through bottles completely filled with the water. The experiments, conducted after Elster and Geitel's method, show that the emanation decays in water at the same rate as in air; the rate of decay of the induced activity also follows the law of Curie-Danne, exhibiting, however, the irregularities described by Rutherford during the first hour. Water from the Vienna supply mains (from springs) behaved similarly, and the author concludes, in agreement with Elster and Geitel [see Abstract No. 2166 (1904)], that the emanations from springs are due to radium minerals in the earth's crust. H. B.

367. *The* N-*rays.* **O. Lummer.** (Phys. Zeitschr. 5. pp. 674–677, Oct. 20, 1904. Discussion at the 76th Naturforscherversamml. zu. Breslau, Sept. 20, 1904.)—The author describes a number of experiments which he and Rubens made for the purpose of confirming the existence of the *n*-rays, but all the results were negative. **P. Weiss,** however, without being willing to accept all that has been published on the subject, stated that from his own preliminary experiments, which are outlined, he is inclined to believe in the existence of an objective effect due to the rays.

L. H. W.

368. *The* N-*rays.* **R. W. Wood.** (Nature, 70. pp. 530–531, Sept. 29, 1904. Elect. Rev., N.Y. 45. p. 630, Oct. 15, 1904. Phys. Zeitschr. 5. pp. 789–791, Dec. 1, 1904.)—The author spent some time in one of the laboratories from which several of the *n*-ray discoveries have originated, and was shown several of the well-known experiments. He was not able to observe any of the effects. L. H. W.

369. *Meaning of the Experiments with* N-*rays.* **E. Gehrcke.** (Phys. Zeitschr. 6. pp. 7–8, Jan. 1, 1905.)—The author describes an attempt at repeating one of Blondlot's experiments, made at the suggestion of Rubens. This consisted in the observation of the change of brightness of a small white paper screen (covered with Balmain's luminous paint and mounted on a larger sheet of black paper) when a file was brought near the phosphorescent surface. With the file above the screen no change of brightness could be detected. The author happened, however, to move the file *underneath* the screen, and noticed at once that a definite shadow crossed the screen as the file was moved past. Later it was found that a pencil, or even the finger, produced the same effect, which was also observed by Lummer and by Rubens. On the file being moved by another person no effect was observable. The author concludes that this is a subjective phenomenon, and he thereupon classes the whole of the *n*-ray observations as being the result of hallucination. It is admitted, however, that the objective photographs of Blondlot's are not yet explained away.

L. H. W.

HEAT.

370. *New Method of Recording Temperature Graphically.* **A. Herlitzka.** (Accad. Lincei, Atti, 13. pp. 447–452, Nov. 20, 1904.)—A description is given of a piece of apparatus for obtaining a graphical record of the temperature of any enclosure such as a liquid bath. The temperatures recorded are only approximate, and great variations in the barometric pressure render the records valueless. A large bulb containing air, ends at its lower extremity in a fine tube, which passes upwards out of the bath and into a test-tube which is floating vertically in some liquid. The lower end of the air bulb is closed by alcohol, which also fills the tube and partially fills the test-tube. When the temperature of the bath rises the air expands, and alcohol is driven over into the test-tube, which therefore sinks somewhat. The test-tube is counterbalanced by a weight, to which it is connected by a cord passing over a pulley. To the weight is attached a pen, against which moves horizontally a strip of paper. When the temperature of the bath rises the test-tube sinks, the pen rising, and *vice versâ.* On account of the presence of moisture and alcohol vapour the scale is arbitrary, but may be determined by means of a standard thermometer in the bath. The details of construction and use are given in the paper. S. G. S.

371. *Effects of Liquid Air Temperatures on the Properties of Iron and its Alloys.* **J. Dewar** and **R. A. Hadfield.** (Roy. Soc., Proc. 74. pp. 326–336, Jan. 23, 1905.)—A preliminary paper. The full results from the 500 specimens examined, comprising pure iron, iron-carbon alloys and alloys of iron with Si, Al, W, Cr, and Cu (and of iron with two of these metals), will be published later with the results of experiments on contraction, electrical properties, micro-structure, magnetic and brittleness tests. All the specimens were machined to test-bars of 0·18 in. diam. The most remarkable results obtained are summarised by the author, the following being the chief points. The effect of low temperature upon the irons and alloys is to increase greatly the maximum tensile stress and, with a few exceptions, reduce the ductility to practically nothing, the absence or presence of carbon seeming to have little influence. Nickel, when tested by itself under these conditions, improves both in tenacity (29–46 tons) and ductility (43–51 per cent.), and nickel in an alloy with little carbon acts as a preventive of brittleness. This action is especially shown in one alloy containing in per cent. 1·18 C, 24·3 Ni, 6·05 Mn; the ductility is extraordinary at normal temperatures and also at low temperatures, the elongation increasing (60–67½ per cent.) and the tenacity (10–38 per cent.). At —182° C. this alloy is far more ductile than the best ductile iron of one-third the tenacity (although it contains 6 per cent. Mn); it appears to reverse all the known laws of alloys. The effect of copper is similar, though less in degree than that of nickel, and it is suggested that copper might be useful to alloy with iron, providing a field for research.

L. H. W.

372. *Heat-conduction in Gaseous Mixtures.* **A. Wassiljewa.** (Phys. Zeitschr. 5. pp. 737–742, Nov. 1, 1904. Communication from the Institut f. physik. Chemie d. Univ., Göttingen.)—If L_1, λ_1 and L_2, λ_2 are the conduc-

tivities and mean free paths in two homogeneous gases at pressure p and temperature T, and L is the conductivity in a mixture of these gases at T, with the partial pressures p_1, p_2, and the total pressure p, in which the mean free paths of the components are $\lambda'_1 \equiv \lambda_1 p/(p_1 + \mathrm{A}p_2)$ and $\lambda'_2 \equiv \lambda_2 p/(p_2 + \mathrm{B}p_1)$, where $\mathrm{A} \equiv (\sigma/s_1)^2\surd\{(1 + m_1/m_2)/2\}$ and $\mathrm{B} \equiv (\sigma/s_2)^2\surd\{(1 + m_2/m_1)/2\}$, these letters having the usual signification, then the expression for the conductivity deduced from the gaseous theory suggests that L must be of the form—

$$\begin{aligned}\mathrm{L} &= (p_1/p)(\lambda'_1/\lambda_1)\mathrm{L}_1 + (p_2/p)(\lambda'_2/\lambda)\mathrm{L}_2 \\ &= \mathrm{L}_1/(1 + \mathrm{A}p_2/p_1) + \mathrm{L}_2/(1 + \mathrm{B}p_1/p_2).\end{aligned}$$

If we know the viscosities μ_1 and μ_2 of the two gases we easily obtain the ratios A/B and s_1/s_2, since—

$$\mathrm{A/B} = (s_2/s_1)^2\surd(m_1/m_2) = \mu_1/\mu_2\,;$$

and if then, as usual, we assume $\sigma \equiv (s_1 + s_2)/2$, we can obtain values for A and B. The conductivities in different mixtures of hydrogen and oxygen were measured by the method of cooling, the effects of radiation and convection, &c., being allowed for. In this case $m_2/m_1 = 16$, $\mu_1 = 0{\cdot}0000885$, $\mu_2 = 0{\cdot}0001959$, whence $\mathrm{A} = 1{\cdot}001$, $\mathrm{B} = 2{\cdot}217$ [corrected values]; but the results of experiment conform to the above formula only with the values $\mathrm{A} = 1{\cdot}379$, $\mathrm{B} = 3{\cdot}064$, which are 1·38 times greater and which would result if σ were taken to be $\surd 1{\cdot}38 = 1{\cdot}175$ times larger than on the above assumption. The relation $\mathrm{L} = \mu c$, where c is the isometric specific heat, which is given by the theory for a homogeneous gas, does not seem to hold good for a mixture. R. E. B.

373. *Determination of the Size of Molecules from the Kinetic Theory of Gases.* **J. H. Jeans.** (Phil. Mag. 8. pp. 692–699, Dec., 1904. Paper read before the British Association, at Cambridge.)—There are, the author says, five ways in which it is possible in theory to determine the size of molecules, namely: (1) By the viscosity of gases; (2) conduction of heat in gases; (3) the coefficient of diffusion in gases; (4) deviations from Boyle's law; (5) the volume occupied by matter in the solid and liquid states. The first question that the reader will ask is, What do we mean by the size of a molecule? If, for instance, it is a centre of force, what is its size? The answer is that it is assumed, for the purpose of this argument, to be an elastic sphere; and it is assumed further that the velocities of the molecules are distributed according to Maxwell's law $\mathrm{A}e^{-h\Sigma m(u^2 + v^2 + w^2)}$—that is, that the chance of any molecule having velocity between u and $u + du$ is, notwithstanding mathematical inconsistency as regards the continuity of the motion, at every instant independent of the positions and velocities of all the other molecules for the time being. On those assumptions it is possible, for instance, to calculate what the viscosity of a gas would be if its elastic sphere molecules had a certain diameter a, and the gas had a certain density. The like may be done for conduction of heat, &c. If the results thus obtained by the independent methods were in fair agreement, the circumstantial evidence would be very strong that, if not actually elastic spheres, the molecules must behave in their mutual relations very nearly as if they were so. According to the author's opinion, given in another place, there is not a very exact accordance between the results of the five methods. If N be the number of molecules in a c.cm., and if molecules are spheres of diameter σ, the first three methods determine $\mathrm{N}\sigma^2$, the last two determine $\mathrm{N}\sigma^3$. The most reliable method in the first class is the viscosity of air, in the last class the deviations from Boyle's law. The coefficient of viscosity as given by Landolt and Börnstein from experiment is, at normal pressure and temperature, 0·0001714; as given by O. E. Meyer, 0·000172. The theoretical formula derived from the kinetic theory of gases is $K = 0{\cdot}350\rho cl$, where l is mean free path, c mean velocity, and ρ density. Using in this formula $\rho = 0{\cdot}001293$, $c = 45{,}100$ cm. per sec., the author finds, referring to another paper of his own, $l = \frac{1{\cdot}255}{\sqrt{2}\pi N\sigma^2}$, Maxwell having given $\frac{1}{\sqrt{2}\pi N\sigma^2}$. From these data he deduces for air $N\sigma^2 = 3{,}306$ sq. cm., which is a solution of the problem subject to the evaluation of N. The determination of N from the kinetic theory is not likely to be accurate. A better way of determining N is the electrical method, because it can be found from the ionic charge. This gives, as the mean of results taken from J. J. Thomson, H. A. Wilson, and J. S. Townsend, $\sigma = 2{\cdot}7 \times 10^{-8}$ cm. Another method is as follows: Using $N = 4 \times 10^{19}$ from the electrical observations, we can apply it to the formula $K = 0{\cdot}350\rho c \frac{1{\cdot}25}{\sqrt{2}\pi N\sigma^2}$ and to the formula $b = \frac{2}{3}\pi N\sigma^3$, where b is van der Waals' known symbol, and by this method the error in the determination of σ is much reduced. If, in the formula for air, $N\sigma^2 = 3{,}306$ sq. cm., we take for N 4×10^{19}, we get, he says, $\sigma = 2{\cdot}86$. [There is, no doubt, here a printer's error for $2{\cdot}86 \times 10^{-\overset{19}{8}}$.] Having found σ for air, the author goes on to show how it may be found for other gases, setting out the results in tabular form. Finally he compares the results thus obtained for gases with those obtained by observations on the density of matter in the solid and liquid states, but points out the difficulty that must attend investigations with regard to solids, because the assumption of spherical molecules is likely to lead to greater errors in their case than in the case of gases. S. H. B.

374. *Persistence of Molecular Velocities in the Kinetic Theory of Gases.* **J. H. Jeans.** (Phil. Mag. 8. pp. 700–703, Dec., 1904.)—The author calls attention in this paper to the well-known fact that if two molecules of a gas collide with each other they have in general before collision a common velocity, that, namely, of their common centre of gravity, and that this common velocity is unaffected by the collision. Further, he points out, as has been pointed out before, that if the molecules are elastic spheres, whatever be the magnitude or direction of that common velocity, all directions of the relative velocity are equally probable. This the author gives on Maxwell's authority only for the relative velocity after collision. On the assumption of Maxwell's law, it is equally true before collision. For if V, R denote the common and relative velocities of any two molecules respectively, E the angle between the directions of V and R, the actual velocities squared are $V^2 + \frac{R^2}{4} - VR\cos E$, and $V^2 + \frac{R^2}{4} + VR\cos E$ respectively. Hence the chance for V and R having those values, and being at angle $E \ldots E + dE$ with each other is proportional to $e^{-h}\left(V^2 + \frac{R^2}{4}\right)\sin E\,dE$, that is, given V and R, it is proportional to $\sin E\,dE$, which proves the proposition. It follows from the two propositions that the expectation of v the vector velocity of either molecule after collision is half of the common vector velocity, as has been pointed out before. It does not, of course, follow that if molecule P has vector velocity V before any collision, the expectation of its vector velocity after collision is $\frac{1}{2}$V, because a collision is more likely to happen *cæteris paribus* with another molecule moving in the opposite direction to P, than with one moving in the same direction—in fact, its frequency is proportional to the relative velocity. The author calculates from these data that if a molecule has travelled a distance ς in given direction since its last collision, then roughly it may be expected to have travelled a distance $\theta\varsigma$ on its previous free path, where $\theta = \frac{1}{4}\left(1 + \frac{1}{\sqrt{2}} \log(\sqrt{2} + 1)\right)$. He points out the importance of these considerations in the theory of diffusion. S. H. B.

375. *Application of the Phase-rule to Mixtures of Iron and Carbon.* **H. W. Bakhuis Roozeboom.** (Zeitschr. Elektrochem. 10. pp. 489–491; Discussion, p. 491, July 22, 1904. Paper read before the 11 Hauptversamml. der Deutsch. Bunsen Gesell., May 12–14, at Bonn.)—The scheme described is in most respects similar to that put forward in 1900. The modifications introduced are three: (1) It is doubtful whether graphite or cementite is stable in contact with iron at high temperatures, and a dotted curve has been added to indicate the possible separation from the melt, of cementite in place of graphite. (2) Carpenter and Keeling have detected a liberation of heat at 800°, which may be due to the formation of a second modification of cementite. It is indicated in the diagram by a horizontal line running across the cementite area. (3) These investigators have also detected a change at 600°, which they attribute to a change in the iron. This change is indicated by a horizontal line running across the pearlite area. It has been suggested that possibly cementite is metastable at all temperatures. Stable equilibrium would then only be possible between iron and graphite. If this be so, however, such an equilibrium would be reached only after very prolonged heating, as under normal conditions cementite is always produced. T. M. L.

376. *Numerical Value of Some Important Physico-chemical Constants.* **W. Nernst.** (Zeitschr. Elektrochem. 10. pp. 629–630, Aug. 19, 1904.)—Berthelot gives the value $R = 0{\cdot}08207$ for the constant in the gas-equation $pv = RT$, where v is measured in litres and p in atmospheres. If R be expressed in absolute units the value is $R = 0{\cdot}83155 \times 10^8 \left\{\text{erg } T^{-1}\right\}$, whilst in gm.-calories $R = 1{\cdot}98507 \left\{\text{gm.-cal.} \times T^{-1}\right\}$. 1 watt $= 0{\cdot}23872$ gm.-cal., and the energy per equivalent per volt of a battery is $96{,}540 \times 0{\cdot}23{,}872 = 23{,}046$ gm.-cal.; the so-called electrolytic gas-constant of the equation $\epsilon = \frac{RT}{n} T \lg \frac{C}{c}$ is $R = 1{\cdot}98507 \div 23{,}046 = 0{\cdot}86134 \times 10^{-4}$. T. M. L.

377. *Solid Solutions between Organic Compounds.* **F. Garelli** and **F. Gorni.** (Gazzetta Chim. Ital. 34. 2. pp. 101–113, Aug. 30, 1904.)—Phenyl salicylate (salol) is a troublesome solvent for cryoscopic measurements, but if the external bath is kept at about 3° below the freezing-point of the solution, so as to obtain superfusion to the extent of about 2°, and if also care is taken in the stirring, concordant results can be obtained. The molecular freezing-point depression is found to be about $K = 123$. Phenyl benzoate and salicylresorcinol give abnormally small depressions in phenyl salicylate salutions, whilst salicylquinol raises the freezing-point even in very low concentrations. Salicylanilide also forms solid solutions with phenyl salicylate, showing that the groups .O. and .NH. in open chains are

isomorphogenic. For phenyl benzoate, the value 80 is obtained for the molecular freezing-point depression. In concentrations greater than 1 per cent., acetanilide gives abnormal molecular weights in phenyl benzoate. Benzanilide also forms solid solutions with phenyl benzoate, confirming the isomorphogenic relations of the groups .O. and .NH. in open chains. Salol also gives abnormally small depressions in phenyl benzoate solution. Antimony tribromide forms solid solutions with bromoform, showing that Sb, like N, is isomorphogenic with CH. T. H. P.

378. *Thickness of Capillary Layer between Homogeneous Phases of Liquid and Vapour and the Critical Phenomena.* **G. Bakker.** (Zeitschr. Phys. Chem. 49. pp. 609–617, Oct. 7, 1904. Ann. d. Physik, 15. 3. pp. 543–558, Nov., 1904. Journ. de Physique, 4. pp. 96–105, Feb., 1905.)—Theoretically speaking, the thickness of this transition layer is indefinitely great. Practically, however, there is a certain length h along which the rate of variation of density is so great that it has to be taken into account in calculating the capillary constant. The author has previously shown that if the form $-f\frac{e^{-\frac{r}{\lambda}}}{r}$ be assumed for the potential function of the attractive forces between the volume-elements, then $h=\frac{6}{5\pi f}\frac{r^2}{\mathrm{H}}$, where r (in the second formula) $=$ inner heat of vaporisation, $\mathrm{H}=$ capillary constant. It may be proved now in several ways that h tends towards the limit ∞ at the temperature where $r=0$, and where the densities of liquid and vapour become identical (critical point of Andrews). The important argument of the paper is that a few degrees under this critical point h will begin to change very rapidly from a very small to a very large value. This point the author calls the "Cagniard-Latour temperature." Between these two temperatures there will thus occur a temperature-region for which there will coexist throughout a relatively considerable length an exceedingly great number of phases of different density between the practically homogeneous phases of liquid and vapour. The meniscus will disappear in or about the Cagniard-Latour temperature, since the variation of density in the transition-layer will cease to be sufficiently rapid to create a practical discontinuity. The author shows that his theory will account for the phenomena observed by Cailletet and Colardeau, de Heen, Teichner, and others, and that it is not necessary to imagine two sorts of different molecules (as is done, for example, in de Heen's theory). The critical phenomena are thus seen to be due to a great (at the critical temperature itself, *infinitely* great) increase in thickness of the capillary transition-layer between liquid and gas. This paper forms a most important contribution to the theory of the critical state, and if the views which it contains can be thoroughly substantiated by experiment—for which there exists already very considerable evidence—they will undoubtedly form the most important advance since the experiments of Andrews and the theory of van der Waals. As the author points out, his theory is not by any means in disaccord with the conceptions of Andrews and van der Waals.

F. G. D.

REFERENCE.

379. *Melting-point Curves of Nitrophenols with Naphthalene.* **A. V. Saposchnikoff.** (Zeitschr. Phys. Chem. 49. pp. 688–696, Dec. 6, 1904.)—German translations of the papers dealt with in Abstracts Nos. 2245, 2247, 2248, and 2249 (1904).

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

380. *The Electrodynamic Potential.* **L. Giuganino.** (N. Cimento, 8. pp. 278–282, Oct., 1904.)—This paper calls in question the notion generally entertained (so at least says the writer) that a closed electric circuit tends always to increase its area if of flexible material, if part of it be movable without breach of circuit. He supposes two circuits, c_1, c_2, carrying currents i_1, i_2, and if $u_1 = i_1\dfrac{dx_1}{ds}$, &c., be the current components, $d\tau$ the element volume, the corresponding components of vector potential are F_1, G_1, A_1, where $F_1 = \int_{c_1}\dfrac{u_1}{r}d\tau$, &c., for the c_1 circuit, and F_2, G_2, A_2 for the c_2 circuit have corresponding meanings. The electrodynamic potential of c_1 on c_2 is then $-\int_{c_1}(u_1F_2 + v_1G_2 + w_1A_2)d\tau_1$, and of c_2 on itself—

$$-\frac{1}{2}\int_{c_2}(u_2F_2 + v_2G_2 + w_2A_2)d\tau_2.$$

He then considers a circuit ABCDA, part of which consists of parallel wires BC, DA, and AB is a sliding piece, which can be moved on BC and DA either to enlarge or contract the circuit ABCDA, or to form part of a new circuit A′B′BA in the same plane with the other. Through each circuit is drawn a plane extending to infinity, the area enclosed by ABCDA being ω_1, that by A′B′BA ω_2, and the external plane area ω_3. If π denote the electrodynamic potential of ABCDA, $\partial\pi$ its variation when AB moves into the position A′B′, it is found by the use of Stokes's theorem that $\partial\pi$ consists of a positive part representing the flux of force due to c_2 through ω_1, and a negative part the flux due to c_2 through ω_3. $\partial\pi$ may therefore have either sign, and the circuit tend to increase or to diminish according as one or the other flux preponderates. He refers to experiments verifying the above theoretical results.

S. H. B.

381. *Electromagnetic Energy of Moving Electrons.* **E. Kohl.** (Ann. d. Physik, 15. 3. pp. 531–542, Nov., 1904.)—A highly mathematical paper following upon the work of Herglotz, Sommerfeld, and especially Schwarzschild, and dealing with the possible screw motion of electrons. The chief results of the analysis are embodied in a triple theorem which may be stated as follows: The speed of rotation of the electron's equator in comparison with that of the translation of its middle point will reach an appreciable value if the variations of the field are of infra-molecular dimensions; the angular speed is small in comparison with that of translation, if the variations of the field are of molecular dimensions; the angular speed becomes vanishingly small in comparison with that of translation, if the variations of the field are of ultramolecular order. [See also Abstracts Nos. 1334 and 1729 (1904).]

E. H. B.

382. *Electric Origin of Gravitation and Terrestrial Magnetism.* **W. Sutherland.** (Phil. Mag. 8. pp. 685–692, Dec., 1904. Terrestrial Magnetism, 9. pp. 167–172, Dec., 1904.)—Without scientific imagination no great discoveries have ever been made, and there is much room for it in the subject of this paper. In the author's theory an electric doublet is represented by the signs of sharp and flat in music. Each sharp corresponds to a positive charge e_1, and each flat to a charge $-e_2$. For each the axis has length c, and the distance between the centres is r. There is then an attraction between sharp e_1 of one and flat $-e_2$ of the other, and repulsion between the two sharps or two flats. The attraction or repulsion would predominate according to the relative orientation of the two axes. But of this variation the author takes no notice in the present paper. He assumes (1) that the attraction between e_1 of one and e_2 of the other doublet is as usual e_1e_2/r^2, but that the repulsion between the two sharps is $(1-b)e_1^2/r^2$, and the repulsion between the two flats is $(1-c)e_2^2/r^2$. This gives for the total force between the doublets an attraction equal to—

$$-\frac{(e_1-e_2)^2+be_1^2+ce_2^2}{r^2} \ldots\ldots\ldots\ldots\ldots\ldots \text{A}$$

He then makes use of J. J. Thomson's formula for the inertia of an electron e spread uniformly over a spherical surface of radius a, namely, $i=2e^2/3a\text{V}^2$, where V is velocity of light, that is, $e=\frac{3a\text{V}^2}{2e}$. Using this in the expression A, we find that if b and c are both zero the result is negative, indicating repulsion, and therefore cannot account for gravitation. The simplest way to do that is to make $ia\text{V}^2/e$ the same for positive and negative electrons, reducing the repulsion term to zero, and then to find proper values for b and c. This is done by reference to the phenomena of terrestrial magnetism, and former works of the author thereon. He finds first that the electric origin of gravitation is expressed by the formula G (the gravitation constant in c.g.s. units) $=g(b+c)a^2\text{V}^2/16e^2$. Also, according to Burgess, $\text{G}=666\times10^{-10}$, and a is found from experiments on the kathode rays to be 2×10^{-13}. Hence $b+c=32\times10^{-44}$. It is now remarked that we are not here concerned with electrons only as they appear in electrolysis and the theory of chemical valence, but with the much larger number of electrons which form, or are said to form, the substance of an atom. Assuming, then, that ether contains electric doublets which give it its electric properties, the magnetic force due to the rotation with the earth of e (sharp) on the sharp of a doublet A in ether will be $1-b$ times as great as the corresponding expression for the flat in A; and the mean magnetic force at A due to the rotation is $1-b/2$ times as great as it would be if e^2/r^2 were the universal law. Similarly for the rotation of the flat with the earth the mean magnetic force is $1-c/2$ times as great as it would be if e^2/r^2 were the universal law. But the earth's magnetic field is the same as would be due to the rotation with the earth of negative electricity. Hence c is algebraically less than b. And he finds by this process that if $\beta=2{\cdot}4\times10^{-22}$, $b=2\beta+\beta^2$, $c=-2\beta+\beta^2$. The field of terrestrial magnetism being proportional to $b-c$ or 4β, that of gravitation will be proportional to $b+c$, or $2\beta^2$.

S. H. B.

DISCHARGE AND OSCILLATIONS.

383. *Chemical Action of Radiation of Short Wave-length on Gaseous Bodies.* **E. Warburg** [and **E. Regener.**] (Preuss. Akad. Wiss. Berlin, Sitz. Ber,

40. pp. 1228–1231, July 28, 1904.)—Ozonisation by the silent discharge is not due to electrolysis but to photochemical or kathodic action [see Abstract No. 603 (1904)]. Analogous effects are produced by the radiation of short wave-lengths from a spark discharge, but the radiation which produces these effects, though it will pass through quartz, is entirely stopped by glass, and therefore must be of wave-length less than $0{\cdot}3\,\mu$. The ozonising and deozonising effect of this radiation is shown by means of a figure, a steady condition being reached when the oxygen exposed to the radiation is ozonised to the extent of 2·2 mols. of ozone per 100 mols. of oxygen originally present.
T. M. L.

384. *Effect of a Luminous Discharge on the Ionisation Produced by Hot Platinum.* **O. W. Richardson.** (Phil. Mag. 8. pp. 400–410, Sept., 1904.)—It was previously shown that the positive leak from hot platinum *in vacuo* fell off in a definite manner with the time, so that a platinum wire which had been heated long enough at a low pressure lost the power of producing positive ionisation. The leaking power can be restored in several different ways, and with one of these—exposure to a luminous discharge—the present paper deals. The paper gives a preliminary account of some of the observations made. The true cause of the phenomena noticed is not yet known, and the experiments are still in progress. It appears probable that the effects produced are connected with the deposition of a material substance on the surface of the testing wire.
J. J. S.

385. *Relation of Electrode Fall in Gases to the Contact Potential Series.* **C. A. Skinner.** (Phil. Mag. 8. pp. 387–400, Sept., 1904.)—The author formerly suggested [see Abstract No. 487 (1902)] that the series of metals, obtained when these were arranged according to the magnitude of the fall of potential at the electrodes when the glow discharge passes through a rarefied gas, is closely related to the contact-potential series. The present paper describes experiments made to study their relation. The hypothesis started with was: The fall of the potential at the *kathode* in a given gas decreases as the *electropositive* value of the metal increases; the *anode* fall, on the other hand, decreases as the *electronegative* value of the metal increases. Care was taken to bring, in rapid succession, the metals to be tested into the same position in one discharge-tube, and measure the electrode fall under invariable conditions. A sketch of the apparatus employed is given in the paper, and the results of the experiments are expressed by means of curves. In the case of hydrogen, the results indicate that the kathode series is the same whatever be the current-density and gas-pressure at which it is taken. The kathode-fall in oxygen exhibits the same qualities as in hydrogen, with the interesting distinction that while the minimum kathode-fall is of about the same magnitude, its increase with current-density and with diminishing gas-pressure is strikingly less than for hydrogen. With the three gases, hydrogen, oxygen, and nitrogen, it is found that the series of metals arranged according to the magnitude of the kathode-fall is the same whatever be the gas-pressure and current-density under which it is obtained. The hypothesis adopted at starting appears to be supported throughout by the experimental results. The electrode fall may be represented as a continuous function of the contact potential of the electrode. The curves show some interesting exceptions. Platinum exhibits a slight tendency to drop below its normal value as kathode, but is in line as anode. Gold appears in general to be displaced in the electrode series to the neighbourhood of tin and lead. This is ascribed to the effect of mercury vapour in that the surface of the gold always bleached while standing *in vacuo*. In nitrogen, cadmium and zinc are displaced to the platinum end in the electrode series, the kathode-fall being for these metals abnormally high, while the anode-fall is abnormally low. In oxygen, copper drops as kathode slightly below its normal position; but steel and nickel form interesting exceptions in being displaced to the vicinity of zinc in the electrode series. A similar inconsistency is exhibited by these metals when the potential series in sulphuric acid and that given by the heat of combination of the metals with it are compared. The electrode-fall is not a constantly increasing quantity in passing from one end of the potential series to the other, but starting with a minimum value at one end, it approaches at a decreasing rate a constant maximum value for the rest of the series. J. J. S.

386. *Lengthening of Spark from Induction-coil by Aid of Auxiliary Wires.* **T. J. Bowlker.** (Phil. Mag. 8. pp. 487–497, Oct., 1904.)—If a discharge is taking place between the ends of two wires connected with the poles of an induction-coil, the ends of the wires being at such a distance that the spark just passes freely, then if an insulated wire be so placed that one end is near the positive terminal, and some other point on the wire is almost touching the wire leading to the positive terminal, the length of the spark is greatly increased. A wire similarly placed with regard to the negative terminal has no effect, if the condenser is properly adjusted. The ratio of the increase depends upon the shape of the terminals, but the actual length of the spark tends towards a maximum almost independent of the shape of the ends. Also, if an insulated wire be placed at right angles to the negative wire, near its terminal, the length of the spark is similarly increased, to some extent if touching the negative wire, to a greater extent if almost touching; whereas when such a wire, if thick (in the experiments one of 3·4 mm. diam. was used), and with well-rounded ends, is similarly placed with regard to the positive wire, it has no effect on the length of the spark. Either of these phenomena give a ready means of determining the nature of the poles of an induction-coil. It is suggested as an explanation that the action of the negative assister in lengthening the spark may be due to the attraction of the negative electrons in the assister and discharged from the assister on the positive electrons. When the negative assister is impulsively charged across its spark-gap this causes an induced impulsive rush in the positive wire, causing the positive electrons to leave the terminal with greater velocity. The effect on the negative assister is probably added to by a discharge of negative electrons from its point when it is impulsively charged. This negative discharge from the point is in an effective position to act attractively upon the positive electrons, and endures long enough to produce its full effect. When the negative assister is surrounded by an insulator, or when a sheet of vulcanite is brought up close to its point, the negative discharge is either entirely prevented or is quickly re-absorbed. J. J. S.

387. *On "Thermo-electric" Discharges.* **D. C. Steinberg.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 36. No. 8. pp. 273–275, 1904.)—When investigating the conductivity acquired by air under the influence of a heated body, the author happened to observe an interesting phenomenon which may be called "thermo-electrical discharge." This phenomenon consisted in the following: Positive electricity was given off freely from a heated solid body through the surrounding air, whereas the latter proved perfectly non-conduct-

ing with regard to any negative charge of the body, all the remaining circumstances being the same. In connection with these investigations, the following experimental outfit was made use of: A spiral platinum wire connected to an ordinary gold-leaf electroscope, the wire having been heated above an alcohol or benzine lamp; the latter was removed, after which the electroscope was immediately given a positive charge. After first repelling each other, the leaves rapidly (after ½ to 1 sec.) fell together. On repeating the same experiment, with negatively charged electroscope leaves, separated to a given angle, these remained immovable. If in the same experiment another electroscope be placed in the neighbourhood of the heated body at 3 to 7 cm. distance, part of the positive charge of the first electroscope will be communicated to the latter through the air; this will keep on until the potential on the heated and cold bodies has become almost identical. In another experiment a body heated to redness was brought near a negatively charged electroscope, the heated body being connected to earth, so as to produce on it by influence a positive charge. At a distance of about 10 to 20 cm. the leaves were found to begin to fall together, and at a distance varying between 3 and 5 cm. the whole charge of the electroscope was annihilated; a positive charge under the same circumstances undergoes no alteration in magnitude. If the heated body be protected against the action of electrical induction by a screen consisting of a grounded conductor, such as, for instance, wire gauze or even cigarette paper, no discharging effect can be observed. A non-conducting disc under the same circumstances rapidly takes a positive charge given off from the heated body, and the falling of the electrometer leaves is at once discontinued. In a third experiment the electroscope, connected by a wire to the heated body, received a certain amount of negative electricity when a negatively charged conductor or dielectric was brought near to the heated body. On approaching positive electricity, no charge of the electroscope was observed. A. G.

388. *Chemical Dissociation and Electrical Conductivity.* **A. E. Garrett** and **R. S. Willows.** (Phys. Soc., Proc. 19. pp. 325–342; Discussion, pp. 342–343, Dec., 1904. Phil. Mag. 8. pp. 437–454, Oct., 1904.)—In a paper by Beattie [see Abstract No. 1376 (1899)] experiments on the leakage of electricity from plates were described, when various mixtures of substances were placed on the plate of an air-condenser and heated. The results obtained by Beattie have been confirmed by the authors and Beattie has also extended his work. The object of the present paper was to discover the origin of the leak and obtain some information as to the nature of the ions. The effects observed in the case of various salts of zinc and some other substances are described in detail, and the experiments are to be continued. J. J. S.

389. *Spark-lengths in Gases, Liquids and Solids.* **W. Voege.** (Elektrotechn. Zeitschr. 25. pp. 1033–1035, Dec. 8, 1904.)—The author gives an account of investigations undertaken with the object of determining whether the law of spark-length is the same for the three states of matter. The discharge was allowed to take place between point electrodes. The gases experimented on were air, hydrogen, coal gas, carbon dioxide and oxygen. An induction coil was employed for producing the spark, and the results of the experiments show that the spark-length with a rapidly varying voltage is the same as that corresponding to a steadily applied voltage equal to the maximum value of the rapidly varying voltage. The liquids experimented on were ether,

petroleum, paraffin oil, linseed oil, lubricating oil, and turpentine. It was found that the dielectric strength of these liquids increased after a number of discharges, and finally reached a steady value considerably in excess of its initial value. The author attributes this to the purifying effect of the discharges, and mentions that in the case of petroleum the colour became purer and the fluorescence disappeared. As examples of solid dielectrics, the author chose glass and mica. He found that the strength of a solid dielectric *depended on the medium in which it was immersed.* Thus, the same sheet of glass 9 mm. thick was punctured with 69,000 volts when immersed in linseed oil, but required 100,000 volts in heavy paraffin oil. The experiments definitely establish the fact that, beyond a certain critical thickness, the spark-length increases in simple proportion to the voltage, so that the voltage V required to puncture a thickness t of a given dielectric, gaseous, liquid, or solid, may be written in the form $V = At + B$, A and B being constants whose values depend on the nature of the dielectric, the medium by which it is surrounded, and the sharpness of the pointed electrodes. Before the proportionality expressed by the above equation is reached, there is a region of instability within which it is impossible to obtain consistent readings. A. H.

390. *Reception by Wires of Electric Waves.* **C. A. Chant.** (Amer. Journ. Sci. 18. pp. 403–419, Dec., 1904.)—The author describes some experiments upon (1) the nature of the disturbance about the receiving antenna in the Braun type system of wireless telegraphy; (2) the radiation from the Braun, Slaby-Arco, and simple Marconi forms of transmitters; (3) the effect on resonance of inserting a coherer in an open wire; (4) exploration of wires receiving the radiation from a simple Marconi transmitter, (5) and a repetition of some of Slaby's fundamental experiments. The work is supplementary to that dealt with in Abstract No. 386B (1904), and the Rutherford type of magnetic detector was again used as measuring instrument. Under (1) a table and curves are given showing the position of the maxima for equal transmitting and receiving antennæ of different length, and with fixed transmitting antennæ and receiving antennæ of different length. No general conclusion can be drawn beyond that in the latter case the oscillation appears to be forced on the wire in the case of the longer wires, while in the case of the shorter wires the oscillation is the natural one of the wire itself. Under (3) the conclusion arrived at is that the coherer does not alter the resonance, but behaves like its length of good conductor, confirming Kiebitz's results. Under (4) an effect was noted which the author considers remarkable. Using a straight Marconi transmitting antenna and a receiving wire bent at the centre at 90°, so that half the wire was perpendicular to the transmitter antenna, the effect was the same as with the straight receiver wire if the lower portion was parallel to the transmitting antenna, but only one-fourth as large if the upper portion was parallel [compare Slaby, Abstract No. 2093B (1904)]. Under (5) the relation between the effect and the distance apart of the transmitter and receiver was examined, the effect being found to be inversely as the simple distance. (The greatest distance tried was, however, only 600 cm.) L. H. W.

391. *Transmission of Musical Sounds by Electric Waves.* **O. Nussbaumer.** (Phys. Zeitschr. 5. pp. 796–797, Dec. 1, 1904.)—To use a singing arc to supply a spark coil the author found it necessary to include, besides the ordinarily used self-induction and capacity (3 microfarads) in series, a further capacity

of 15 microfarads in shunt to the arc in order to produce a singing of the arc. Using 150-volt current, and the lamp current being adjusted to 2 amps., the current between the arc and the shunting capacity was 12 amps., that beyond (through the coil primary) 3 amps. Under these circumstances a 2-cm. spark-gap in the coil secondary gave precisely the same note as the arc. Using such an arrangement to charge a Braun type oscillatory circuit, tunes can, it is said, be transmitted by means of the waves to a wireless receiver circuit. The coil can also be worked by a shunted microphone in place of the interrupter. Diagrams are given, but the receiver used is not described. L. H. W.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

392. *Electrical Conductivity of very Dilute Solutions of Hydrochloric and Nitric Acids.* **H. M. Goodwin** and **R. Haskell.** (Amer. Acad., Proc. 40. 7. pp. 399–415, Sept., 1904. Phys. Rev. 19. pp. 369–386, Dec., 1904.)—Owing to the presence of impurities in the water (which neutralise a part of the acid) the molecular conductivities of the acids do not increase at the highest dilutions, but reach a maximum at 500 to 2,000 litres and then decrease again. In the present paper measurements are given of solutions of nitric acid from 0·001 to 0·00025-N and of hydrochloric acid from 0·1 to 0·00025-N. The water used had a conductivity of 0·8 to 1·5 × 10^{-6}. To eliminate the effect of impurities in the water two methods were used, depending on the assumption that the total effect of the interaction of the acid with the impurities is produced when a relatively small proportion of acid has been added to the water. The final values for the equivalent conductivity were as follow :—

m.	Λ_{HCl}.	Λ_{HNO_3}.	*m.*	Λ_{HCl}.
0·0	380·1	377·0	0·005	372·6
0·00025	377·6	374·5	0·010	369·3
0·00050	377·0	373·9	0·020	365·5
0·00075	376·2	373·3	0·030	362·5
0·00100	375·9	372·9	0·05	358·4
0·00150	375·6		0·10	351·4
0·00200	375·3			

The values for infinite dilution were deduced on the assumption that the change from 0·00025 to 0·0 is in the same ratio as in the case of neutral salts. The final values are 1 per cent. lower than those of Kohlrausch, and are believed to be substantially correct. That derived by Noyes and Sammet from transference experiments for hydrochloric acid is, for some reason as yet unknown, 4 per cent. higher. T. M. L.

393. *Specific Velocity of the Ions in badly conducting Liquids.* **E. v. Schweidler.** (Akad. Wiss. Wien, Sitz. Ber. 113. 2a. pp. 881–902, June, 1904. From the II. Physikal. Institut der k.k. Univ. in Wien.)—Employing e.m.f.'s up to 300 volts, galvanometric measurements of the stationary current in petroleum, petroleum and hexane, toluol and olive oil have been made. The results do not agree with the simple theory of ionic conduction in gases as worked out by J. J. Thomson and Rutherford. The author comes to the conclusion that the liquids employed contained a number of ions of different mobilities. Owing to the removal of the faster moving ions by the current the specific conductivity falls on application of an e.m.f. Different experiments

with the same "substance" give fairly constant values for the mean sum of the specific mobilities of the positive *plus* negative ions. The author admits that the substances employed were not specially purified, and that the observed conductivities may be largely due to accidental impurities (*e.g.*, traces of water). Progress in this field will doubtless depend on the employment of substances possessing a degree of purity far beyond that demanded by the chemist. F. G. D.

394. *Comparison of Small Inductances at High Frequencies.* **A. H. Taylor.** (Phys. Rev. 19. pp. 273–280, Oct., 1904.)—After mentioning various methods of measuring small inductances [see Abstracts Nos. 153 and 355 (1904)], the author describes a new method depending upon the production of resonance in an auxiliary circuit. This circuit is tapped on to two adjacent points on a wire forming either part of a circuit in which oscillations are produced by an induction coil and spark-gap in the usual way, or part of a secondary circuit attuned to the latter. The second method is the better for high frequencies and low inductances, as it enables the auxiliary circuit to be placed at some distance from the primary circuit, and so diminishes the chance of its reacting on the latter. The auxiliary circuit consists of (1) a capacity, (2) the inductance to be measured, (3) a variable and calculable self-induction formed of two parallel wires and a slider, (4) an iron-constantin couple with a d'Arsonval galvanometer to indicate maximum resonance. The distance between the two adjacent points is adjusted to give a suitable amplitude of oscillation when resonance occurs. To measure an inductance, resonance is obtained first with it in the auxiliary circuit and then with it removed, the slider in the second case having to be moved so as to add an inductance equal to that to be measured. Inductances of the order of 1 micro-henry can be measured with an accuracy of about one-third of 1 per cent. The inductance of a circular loop 4·82 cm. in diam. was measured as 110×10^{-9} henries with an accuracy of 5·3 per cent. The method may also be used to measure high frequencies, by obtaining resonance with two different capacities successively in the auxiliary circuit. The periodic time—

$$T = 2\pi \sqrt{C_2 \times C_2' \times dL} / \sqrt{(C_2 - C_2')},$$

where dL is the difference between the inductances necessary for resonance in the two cases. Periods of less 1×10^{-6} were determined to within 1 per cent. of accuracy. J. D. C.

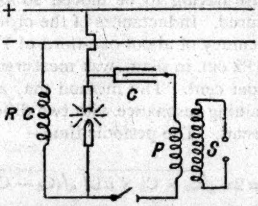
395. *A Property of Opaque Minerals.* **G. Cesàro.** (Bull. Acad. Roy. Belg. pp. 115–122, 1904.)—An attempt is made in this preliminary paper to show that the electrical conductivity can be used as a means of identification in mineralogy in place of hardness and density tests. The minerals are simply tested by means of a battery and 5-volt lamp; if a good or medium conductor the lamp glows more or less brightly, or not at all if a non-conductor. As a result it is found that (1) all transparent bodies are non-conductors; (2) all silicates, sulphides, and oxides are non-conductors, excepting magnetite in the latter class, which is a good conductor; (3) As, Sb, Te seem to lend their conductivity to their compounds, S its resistance. Marked exceptions are pyrites, marcasite, and cobalt-glance, which are bad or good conductors according as the direction of the channeling is parallel or perpendicular. The two modifications of cinnabar of the same chemical composition follow this rule—cinnabar (rhombohedric, transparent), bad conductor; meta-cinnabarite (tetrahedric, opaque), good conductor.

L. H. W.

396. *Influence of Temperature on the Electrical Conductivity of Lithium.* **A. Bernini.** (N. Cimento, 8. pp. 269–278, Oct., 1904. Phys. Zeitschr. 6. pp. 74–78, Feb. 1, 1905.)—The resistance of a tube of lithium is determined by the Thomson double-bridge method. The method of filling the tube, making contact at the ends, &c., is described. The tube is immersed in baths at various temperatures. It is found that the resistances at the same temperature coincide, whether the experiment is made with rising or with falling temperature, except in the case in which the melting-point has been reached. The author's results agree with those of Matthiessen. At the end of the paper a table is given of the relative resistance for temperatures from 0° to 230°. On melting, the resistance increases in the ratio 2·51. The mean value found for the melting-point is 177·84°.

S. G. S

397. *Arc Interrupter.* **H. Mosler.** (Elektrotechn. Zeitschr. 25. pp. 1014–1015, Dec. 1, 1904.)—The author finds that an excellent form of interrupter for an induction coil may be obtained by using the arrangement shown in the Fig., in which an arc lamp is joined in series with a reactance coil RC across the mains, and the primary P of the induction coil is connected in series with a condenser C, and then across the arc-lamp terminals; S denotes the secondary of the coil. Using a condenser of 9·27 microfarads and a continuous voltage of 75 across the lamp, the author obtained a high-frequency alternating current of 3·4 amps. in the primary, which gave a spark-length of about 5 cm. Arc lamps of the enclosed type are especially suitable for this purpose, as they take a high voltage. Such an interrupter possesses the great advantage of being capable of working *continuously*, which cannot be said of the liquid interrupters of Wehnelt and Simon. The effect may be increased, if necessary, by using several arcs in series. A further advantage of the arrangement is that the switch or key for closing or opening the primary circuit is in a low-voltage alternating-current circuit, and the sparking trouble is absent; this feature is of particular importance in connection with wireless telegraphy.



A. H.

398. *Effect of Temperature on the Conductivity of Selenium.* **K. Aichi** and **T. Tanakadate.** (Mathematical and Physical Soc., Tokyo, 2. 16. pp. 217–221, 1904.)—The authors describe an investigation into the question of the temperature coefficient of selenium as an extension of Ries' work, but using a cell of the type described by Pfund [see Abstract No. 363 (1904)]; this is heated up in a flask by an air bath, the conductivity being measured instead of the resistance, owing to the ease with which the results can be graphically represented in the former case. The results are summarised as follows: The selenium cell can be given a large range of conductivity and a large range in which the temperature coefficient is positive, by cooling from some suitable temperature (210°–220° C.). There is a definite path in the cycle of conductivity, resembling in some respects the curve of saturated solution, and a supersaturated and unsaturated state can also be obtained. The behaviour to temperature change is the same with pure or selenide-containing selenium and whether the electrodes are of copper or carbon. The change of conductivity depends upon change of structure, and takes place by annealing or by exposing the selenium to light. Pfund's theory is thus held to be confirmed. L. H. W.

ELECTROPHYSIOLOGY AND ELECTROTHERAPEUTICS.

399. *A New Theory of Phototropism.* **G. Bohn.** (Comptes Rendus, 139. pp. 890–891, Nov. 21, 1904.)—The important factor in the orientation of an animal is not the direction of the rays of light nor the position of surrounding objects, it is solely the degree of illumination of the two eyes. The light received by the eye has, through the nervous system, an action on the muscles of the same side, which is exciting or inhibitory according to circumstances. If, on an horizontal plan, for example, one joins together all the points which present the same degree of illumination, one obtains equipotential lines of the luminous field. At a given point the animal must orient itself, following the normal in the line of equipotential passing through that point, and the trajectory followed will be the lines of force of the luminous field. In fact, a Littorine, for example, behaves in the luminous field thus defined like a needle in a magnetic field. In an analogous manner, when a Littorine is withdrawn from the action of light, it orients itself, following the lines of force in the field of action of gravity. The direction, however, of the force which orients the animal undergoes oscillations about a mean position, and does not coincide rigorously with the direction of the luminous field above described. The trajectories followed by the animal may be obtained by supposing that the lines of force traced in the luminous field undergo incessant changes of form which resemble the changes of form of the lines of force of the magnetic field; but the changes of form in this case are the consequence of biological modifications of living matter.

H. W. P. Y.

400. *Actual State of Radiotherapy.* **J.R. Costa.** (Archives d'Él. Médicale, 12. pp. 891–909, Dec. 10, 1904.)—The author discusses the present-day uses of radiotherapy in various diseases. As a depilatory in hirsutics it is of great value, while, on the other hand, he has found it successful in the treatment of patches of alopecia. In sycosis, tinea, favus, and herpes tonsurans depilation by this method should be the first procedure, since the germicidal action of the rays will be called into play at the same time. A case of rhinoscleroma improved under radiotherapy, but his results with lupus erythematosus were unsatisfactory. A series of photographs of cases of epithelioma of the face are given, illustrating the success obtained. In this affection he employs very soft tubes, except when there is much infiltration. When the epithelioma presents warty excrescences which do not quickly yield to

the rays, the author cauterises them with high-frequency sparks—a procedure which considerably shortens the process of repair. Rapidly growing epitheliomata of the lips and tongue and inner side of the cheeks, with ganglionic enlargement, do not derive much benefit from the rays. The more slowly growing epitheliomata are alone modified. For growths of the pharynx and soft palate special tubes should be employed, which can be taken in the hand and held in contact with the diseased area. Such tubes require specially constructed coils or the static machine, so that one of the poles can be connected to earth so as to prevent shocks to the patient. For laryngeal epitheliomata he employs external applications with tubes of high penetration. The methods of measuring the intensity and penetration of the rays are discussed. Some method of measuring the dosage is indispensable, for it is most important not to carry the treatment too far.
H. W. P. Y.

REFERENCES.

401. *Solid Dielectrics.* **V. Crémieu** and **L. Malclès.** (Comptes Rendus, 139. pp. 969–972, Dec. 5, 1904.)—Further experiments which confirm the results already obtained [see Abstract No. 154 (1905)]. When the field to which the dielectric is submitted is taken through a cycle the reactive charge shows a hysteresis effect. R. S. W.

402. *Quick-working Water-collector.* **D. Smirnow.** (Phys. Zeitschr. 5. pp. 597–599, Oct. 1, 1904.)—A description is given of an apparatus for measuring the strength of electric fields in the atmosphere, which may be used with balloons. The essential part of the apparatus consists of a pulveriser, by which a stream of very fine water particles or water dust may be produced. It is a modification of the water-collector, and works from three to four times more rapidly than the arrangement in which a candle-flame is used; it is thus suitable for observations where the potential of the air changes quickly. J. J. S.

403. *Electric Dispersion at the Source of the Acquasanta.* **C. Carpini.** (Accad. Lincei, Atti, 13. pp. 444–447, Nov. 20, 1904.)—Measurements of the coefficient of electric dispersion of the air in the caves at the source of the Acquasanta are made. It is found that this coefficient is not so great as for external air. The mud in the caves is then examined for radio-activity, but this is found to be inappreciable. An account of the geological formation of the caves is given. S. G. S.

404. *Effect of Pressure on the Light from an Electric Arc.* **W. J. Humphreys.** (Phys. Rev. 19. p. 300, Oct., 1904. Abstract of paper read before the Amer. Physical Society, St. Louis, Sept. 16, 1904.)—The decrease in wave frequency of the light emitted by the arc in air at high pressure, which had previously been observed by Mohler and the author, were confirmed, and the observations extended to somewhat higher pressures. S. G. S.

405. *Radium and the Electron Theory.* **J. Trowbridge** and **W. Rollins.** (Phil. Mag. 8. pp. 410–413, Sept., 1904.)—Description of an experiment made to test whether the radiations from radium had any effect on an electric current passing through aluminium. The result was negative. The radiation from radium bromide, which could be observed through a slab of iron an inch thick, had no apparent effect upon the mechanism of the electric current in an aluminium wire. J. J. S.

406. *Synthesis of Stearic Acid by the Electric Discharge.* **A. de Hemptinne.** (Bull. Acad. Roy. Belg. pp. 550–556, 1904.)—Oleic acid is converted under the action of the electric discharge into stearic acid to the extent of about 50 per cent. in 10 hours. The apparatus is described in detail. L. H. W.

407. *Fog-dispelling Apparatus.* (Electrician, 54. pp. 352–353, Dec. 16, 1904.)—Description of apparatus patented by O. J. Lodge for above purpose. It consists of the combination of high potential rectifiers, arranged in quadrilateral groups of four or multiples of four in such a way that instead of the reverse pulses of an alternating current being suppressed or non-existent, as at present, they are redressed to form the positive and negative discharging streams required for the deposit purposes. The rectifier employed is similar to the Cooper-Hewitt lamp. E. C. R.

408. *The Moving-coil Galvanometer in the Aperiodic Limiting State.* **W. Jaeger.** (Zeitschr. Instrumentenk. 23. pp. 261–270, Sept., and pp. 353–360, Dec. 1903.)

409. *Attachment for the Suspension-wires of Galvanometers.* **O. Toepfer** and **Sohn.** (Zeitschr. Instrumentenk. 24. pp. 268–271, Sept., 1904.)—A convenient suspension head is described and illustrated in which arrangements are provided by which (1) the suspension-wire or strip can be clamped for portability, (2) the wire can be easily replaced and adjusted without danger of rupture, (3) the zero position of the coil and its height may be varied as desired. J. D. C.

410. *Differential Galvanometer of the d'Arsonval Type.* **J. C. Shedd.** (Phys. Rev. 19. pp. 301–304, Oct., 1904. Abstract of paper read before the Amer. Physical Society, St. Louis, Sept. 16, 1904.)—A brief description of a trial differential d'Arsonval galvanometer. E. C. C. B.

411. *New Slide-wire and Wheatstone Bridge.* **A. Coehn.** (Zeitschr. Elektrochem. 11. pp. 12–14, Jan. 6, 1905.)—The author describes a form of Wheatstone bridge with slide-wire suitable for electrochemical measurements after Kohlrausch's method, which was built by the firm of Ruhstrat Bros. to his design. The slide-wire, 2·5 m. long, is wound on a cylinder 65 mm. diam., and contact is made by one external and one internal arm mounted on the central revoluble portion, as in the Ruhstrat variable resistances (better known on the Crompton potentiometer). By this means there are only two contacts in place of four, and one only of these is exposed to the atmosphere. The scale, which is also mounted on the revoluble portion, is engraved upon a hollow tube which surrounds the wire-cylinder after the manner of the Fuller slide-rule. L. H. W.

412. *Automatic Commutator and Galvanometer Key for Measuring Periodic Phenomena.* **A. W. Gray.** (Phys. Rev. 19. pp. 293–297, Oct., 1904. Ann. d. Physik, 15. 3. pp. 596–601, Nov., 1904. Physik. Institut d. Univ., Berlin, April, 1904.)—The key was originally designed for measuring ballistically the individual charges or discharges given to a Siemens ozone generator. The instrument described and illustrated consists of a rotating commutator and key combined, so that the commutator controls the charges or discharges given to the ozone generator or condenser, &c., whilst the key enables a single charge or discharge to be diverted through a ballistic galvanometer, according as one or other of two knobs is depressed. When neither knob is depressed a self-inductive resistance equal to that of the galvanometer is inserted in the circuit, so that the conditions are unaltered by the interchange. The instrument is suitable for use with pressures up to many thousands of volts. J. D. C.

413. *Colouring of Much-used Röntgen-ray Tubes.* **B. Walter.** (Fortschr. a. d. Gebiete der Rontgenstr. 7. pp. 115–120, 1904.)—The author finds that the greater part of the colouration produced in a well-used, good tube is not due to an internal metallic deposit, but to an actual chemically-produced colouring of the glass, which can be temporary or lasting. A colouring produced by kathode pulverisation often takes place along with this actual one. L. H. W.

414. *The Electrolytic Wireless Telegraph Detector.* **J. E. Ives.** (Elect. World and Engineer, 44. pp. 995–997, Dec. 10, 1904.)—The experiments with the detector which were referred to in de Forest's papers [see Abstracts Nos. 2689B and 2958B (1904)] are here detailed without anything additional beyond references to the work of Pupin, Reich, and Dieckmann. That of Rothmund and Lessing [see Abstract No. 2971 (1904)], which conflicts with one of the author's statements, is, however, not referred to. The name *polariter* is suggested for the polarisation cell type of detector. L. H. W.

415. *Nature of Thermoelectric Force.* **C. B. Thwing.** (Phys. Rev. 19. pp. 299–300, Oct., 1904. Abstract of paper read before the Amer. Physical Society, St. Louis, Sept. 16, 1904.)—Numerous measurements of the coefficient of expansion at different temperatures and of the thermoelectric force were made, with the view of testing the hypothesis that an electric current in metals consists in the displacement of negative corpuscles. The results in all cases confirmed the hypothesis. Those metals with negative e.m.f. have a negative rate of increase of expansion and *vice versâ*. When one effect is high the other is also high. In the case of the alloys of Ni-Cu, Sb-Zn, Sb-Cd, which have an e.m.f. much higher than either constituent, the coefficient of expansion is abnormally low. The author shows that this is in agreement with the hypothesis. S. G. S.

416. *Treatment of Cancer by Röntgen Rays.* **Tuffier** and **Haret.** (Archives d'Él. Médicale, 12. pp. 843–852, Nov. 25, 1904.)—This paper contains an account of three cases of recurrent carcinoma of the breast and five cases of epithelioma of the face or mouth, all of which appeared to have been caused by radiotherapy, The author comments on the fact that the malignancy of epitheliomata of the face and mouth varies greatly according to the position of the growth. Radiotherapy is indicated in all cases of rodent ulcer, in all cases of cutaneous epithelioma in which surgical intervention is for some reason unadvisable, in all recurrent cancers of the breast, and after extirpations of neoplasms in order to prevent recurrence. H. W. P. Y.

417. *Radio-dermatitis occurring simultaneously in both Patient and Operator.* **H. Guilleminot.** (Archives d'Él. Médicale, 12. pp. 883–886, Dec. 10, 1904. Communication to the Congrès de l'Assoc. Française pour l'Avancement des Sciences, Grenoble, Aug., 1904.)—As the result of a search for a foreign body in the hand with the fluorescent screen the patient developed a burn, symptoms of which first appeared at the end of eight days. The operator, who held the patient's hand in his own during the exposure, received a similar injury to this hand and also to the other hand, in which he had held a pair of forceps during the operation. In his case symptoms developed four days after the séance, and the burn was much more severe and took much longer to heal. The interest lies in the difference in the latent periods and the difference in the degree of severity of the burns in the two cases, which appears to afford evidence in favour of the theory of idiosyncrasy. H. W. P. Y.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

418. *Chemical Valency.* **J. Billitzer.** (Monatshefte für Chemie, 25. pp. 745–773, Aug. 25, 1904.)—The author is of opinion that an element possesses neither a constant nor a predominating valency, but that variations occur with the temperature. Thus, at the ordinary temperature, carbon is tetravalent and acetylene therefore unsaturated, whilst at a high temperature such as that of the electric arc, carbon is divalent and acetylene saturated. When a reaction is accompanied by change in volume, the valency of an element may be affected by changes of pressure. At 3,000° under a pressure of 0·001 atmosphere, 94 per cent. of carbon dioxide decomposes into carbon monoxide and oxygen, whereas under 100 atmospheres pressure only 10 per cent. of carbon dioxide is decomposed. In both cases the carbon partly becomes divalent, the higher pressure favouring tetravalency. The valencies of the elements in a group of the periodic system vary inversely with the vapour pressure. T. H. P.

419. *Oxidation of Thiocyanic Acids and its Salts by Hydrogen Peroxide.* **J. H. Kastle** and **C. R. Smith.** (Amer. Chem. Journ. 32. pp. 376–385, Oct., 1904.)—Results are given of an investigation of the influence of small proportions of various oxygen-carriers on the action of hydrogen peroxide on thiocyanic acid and its barium and potassium salts. Thiocyanic acid is more rapidly oxidised than either of the salts, both in presence and absence of oxygen carriers. The oxidation is greatly accelerated by various substances, especially those which effect the decomposition of hydrogen peroxide, such as chrome alum, copper sulphate or nitrate, or ferrous sulphate. Nickel and cobalt salts hasten the reaction with thiocyanic acid, but have little effect on the oxidation of the salts. Platinum black, manganese dioxide, and potassium iodide do not influence the reaction appreciably. The study by van't Hoff's method of the oxidation of thiocyanic acid by hydrogen peroxide, $HCNS + 3H_2O_2 = HCN + H_2SO_4 + 2H_2O$, shows it to be of the third order. The reaction probably takes place in two stages : (1) $HCNS + 2H_2O_2 = HCN + 2H_2O + SO_2$, and (2) $SO_2 + H_2O_2 = H_2SO_4$. T. H. P.

420. *Intramolecular Atomic Rearrangements in Benzpinacones.* **P. J. Montagne.** (Konink. Akad. Wetensch. Amsterdam, Verslag, 13. pp. 253–256, Oct. 6, 1904. Proc. 7. pp. 271–275, Nov. 23, 1904.)—The author has already shown that in the transformation of hydrobenzoin into diphenylacetaldehyde no intermediate product is formed similar to that assumed by Nef in the conversion of benzpinacone into benzpinacoline, and the doubt thus cast on Nef's theory is now confirmed by the conversion of 44′4″4‴ tetrachlorobenzpinacone into trichlorotriphenylmethane identical with that obtained from triaminotriphenylmethane. On heating the tetrachlorobenzpinacone, obtained by reducing 44′ dichlorobenzophenone with acetyl chloride, it passes into tetrachlorobenzpinacoline, which when boiled with alcoholic potash is resolved into trichlorotriphenylmethane and *p*-chlorobenzoic acid, proving that the phenyl group is attached to the same carbon atom before and after the migration, so that the suggested intermediate product is impossible. In the transformation of the 1.2 glycols into aldehydes, a real intramolecular atomic rearrangement is considered to take place which cannot be explained by any normally-proceeding intermediate reaction, but whether it occurs with the glycols themselves, or whether the oxides are first formed and then undergo intramolecular rearrangement has not yet been proved. W. H. Si.

421. *Nitration of Disubstituted Benzenes.* **A. F. Holleman.** (Konink. Akad. Wetensch. Amsterdam, Versl. 13. pp. 240–243, Oct. 6, 1904. Proc. 7. pp. 266–269, Nov. 23, 1904.)—If when a group Z is introduced into two mono-substituted benzene derivatives in which the substituent groups are X and Y, *o*-, *m*-, and *p*- compounds are formed in the proportions of $p : q : r$ and $p' : q' : r'$ respectively, then on introducing Z into a disubstituted derivative C_6H_4XY, the quantities of the isomers produced should be expressed by the products pq', qr', rq', qp', provided X and Y each exert an independent directing influence on Z. An investigation of the relative quantities of isomers formed when substances of the type C_6H_4XY are nitrated, shows that they generally differ very considerably from the products pq', &c., a serious diversion of the directing influence on the third substituent taking place which depends not only on the nature of the substituents, but also on their place in the molecule, as is shown by the following table, in which the "diversion" is the quotient of the quantity of bye-product actually found and that calculated.

Substance Nitrated.	Amount of Bye-product on 100 parts of Main Product.		Diversion of the Directing Influence of—			
			The Halogen.		Carboxyl.	
	At − 30°.	at 0°.	At − 30°.	At 0°.	At − 30°.	At 0°.
C_6H_5Cl	36·4	42·0	—	—	—	—
C_6H_5Br	52·7	60·5	—	—	—	—
C_6H_5COOH	16·9	23·1	—	—	—	—
o-$C_6H_4Cl . COOH$	16·3	19·1	0·448	0·455	—	—
o-$C_6H_4Br . COOH$	20·6	24·4	0·391	0·403	—	—
m-$C_6H_4Cl . COOH$	9·1	9·5	0·250	0·226	0·539	0·411
m-$C_6H_4Br . COOH$	13·4 (?)	12·9	0·254 (?)	0·213	—	0·601
o-$C_6H_4Cl_2$	5·5	7·8	0·151	0·186	—	—
m-$C_6H_4Cl_2$	2·7	4·1	0·074	0·098	—	—

W. H. Si.

422. *State in which Helium exists in Pitchblende.* **R. J. Moss.** (Roy. Dublin Soc., Trans. 8. 12. pp. 153–160, Nov. 3, 1904.)—A specimen of pitchblende from Joachimsthal, which had been in the Science and Art Museum, Dublin, for about forty years, was broken into fragments of about 2 to 3 gm. each and dried in a desiccator over sulphuric acid. The fragments, weighing 72·7 gm., were transferred to a mill for grinding substances in vacuo and kept in vacuo during 24 hours. On grinding the mineral, moisture was at once liberated and gas collected, amounting to 0·092 c.cm. at 0° and 760 mm., but reduced to 0·078 c.cm. by the action of potash, and 0·076 by the action of phosphorus. The gas was then transferred to an exhausted Plücker tube with magnesium terminals; at first the tube gave only a nitrogen spectrum, but this soon faded and was succeeded by an almost pure helium spectrum. A second grinding gave a similar result. The composition of the gas was

estimated to be CO_2, 18·35 ; He, 48·27 ; N_2, &c., 33·38 per cent. When fused with potassium hydrogen sulphate 25 gm. of the powdered mineral gave 73·8 c.cm. of gas at 0° and 760 mm. The composition of this gas was CO_2, 93·35 ; O_2, 0·15 ; He, 2·11 ; N_2, 4·39 per cent. In this experiment 10·3 gm. of the mineral was unchanged and the gas liberated was from 14·7 gm. only. The author inclines to the view that the gas is contained in minute cavities in the pitchblende, and that only a few of the cavities are broken into when the mineral is ground, but no definite evidence is given in support of this view.

T. M. L.

423. *Irregularities of the Atomic Weights of Beryllium, Argon, and Tellurium.* **E. W. Wetherell.** (Chem. News, 90. pp. 260–262, Nov. 25, 1904.)—If the number 4 and its multiples up to 4^4 are taken and those elements of groups 0, 2, 4, and 6 which have multiples of 4 for their atomic weights arranged in their proper positions according to the periodic system, a table is obtained of which the first part is as follows :—

He 4		C 12	O 16
Ne 20	Mg 24	Si 28	S 32
	Ca 40	Ti 48	Cr 52, &c.

If in this table the missing multiples of 4 are inserted, it is found that two multiples of 4 occasionally occur in the same space, and that with the single exception of beryllium, the experimental values of these elements always lie within the limits of the two multiples which happen to occur together, *e.g.*, Zn, 65·4, lies between 64 and 68. The various abnormal properties of beryllium—low specific heat, &c.—are doubtless dependent on its abnormal atomic weight, and in order to explain them the author proffers the suggestion that the atoms of an element may in some cases have a satellite, a minute body inseparable from the atom by any means at our disposal, yet one which may materially affect the properties of an element. Such a satellite would not upset the law of Avogadro and might even account for the observed slight deviation from the law. In the case of beryllium, the satellite would be large (1) compared with the beryllium atom (8) itself, so that the properties of the latter would be considerably altered. With tellurium, however, the satellite would have a small weight (4) compared with that of the tellurium atom itself (124). The existence of the satellite in the latter case may be the cause of the inversion of tellurium and iodine in the periodic arrangement of the elements.

T. H. P.

424. *Occurrence of Zinc, Cadmium, and Mercury in the Group of the Alkaline Earth Metals, of Tin and Lead in the Carbon Group, and of Copper, Silver, and Gold in the Alkali Metal Group.* **E. W. Wetherell.** (Chem. News, 90. p. 271, Dec. 2, 1904.)—In following up the views previously expressed [see preceding Abstract], the author finds that the elements which have almost exact multiples of 4 are more typical of their groups than those lying between two multiples, and it is therefore possible that only one multiple can occur in any one space and that the deviation of an element is due in other cases to the presence of a satellite. The lowest multiple for zinc is 64, for cadmium 108, and for mercury 196. These atomic weights require relatively large companions to bring them up to the experimental values, and it is to these that they owe their metallic properties ; without these companions, the elements α-Zn, α-Cd, and α-Hg would be alkaline earth metals. The weight of the possible satellite of barium is only 1·2, which is very small in relation to the weight of barium itself. These satellites possibly have some action in preventing the linking of the atoms of zinc, cadmium, and mercury in the free state, thus making their molecules monatomic. According to the author's theory, the members of the carbon group other than tin and lead can have no satellites (or only very small ones), whilst the two metals, which should have atomic weights of 116 and 204 respectively, must have comparatively large satellites. The theory is applied to some other cases.

T. H. P.

425. *Regularities in Homologous Series.* **O. Biach.** (Zeitschr. Phys. Chem. 50. pp. 43–64, Nov. 18, 1904.)—Homologous series very generally exhibit regularities similar to the alternation of high and low melting-points first pointed out by Baeyer. The author brings forward a mass of data illustrating this. With the freezing-points, this alternation often appears only in the differences (sometimes only in the second differences), as, for example, in the paraffins up to $C_{20}H_{42}$. In the case of the boiling-points the variations are less marked, but an oscillation in the differences often occurs, *e.g.*, in the second differences of the boiling-points of the normal paraffins, alkyl bromides and primary alcohols. The author refers also to the molecular volumes, internal friction and rotatory power, where the regularities are less distinct, this being also the case—in a still higher degree—with the dissociation constants, the velocities of reaction, the dielectric constants, &c. The author explains these regularities on the supposition that atoms and atomic groups regarded as equivalent really possess different valencies, that in substitution by different groups, varying residual valencies remain. If, for example, the valency of hydrogen is taken as less than one-fourth that of carbon, it is easy to show that CH_3 has a less valency than hydrogen, C_2H_5 a greater one than CH_3, &c. Hence we obtain an alternation in the sign of the valency inequalities for successive groups. The variations of the valency differences of the groups must become smaller as the number of atoms increases. Where a property is dependent on the valency of the group, it must exhibit oscillation in value; but where the property is mainly dependent on the mass of the molecule, the oscillation is indistinct or only becomes noticeable in the differences. The author's hypothesis requires the existence of two kinds of acids: (1) those in which the hydrogen is not combined by means of its whole valency; these are readily dissociated, and therefore obey Ostwald's dilution law; (2) those in which the atom united with the hydrogen has a part of its valency left over, so that in aqueous solution it takes up water, the hydrate thus formed dissociating; such acids would not follow the dilution law. The same holds for bases. The results obtained by Fichter and Pfister [Liebig's Annalen, 334. p. 201, 1904] are in accord with the author's hypothesis. T. H. P.

426. *Classification of Glass for Chemical Purposes.* **F. Mylius.** (Extract from Ber. des V. Internation. Kongresses für angew. Chemie zu Berlin, 1903, Section II. Vol. 1. p. 678.)—Discusses the requirements for glass for chemical apparatus, particularly as regards chemical attack by alkaline, acid, and neutral liquids. A classification for glasses for chemical purposes is suggested on the basis of the amount of hydrolysis produced by cold and hot water. The amount of such hydrolysis may be determined either chemically or by measurements of electrical resistance of water after contact with the glass. The actual amount of alkali dissolved from glass by water is very small, and delicate methods are required for its estimation. The following table gives the classification suggested by the author, and the amount of alkali dissolved by water at 18° C. acting for 8 days and by water at 80° C. acting for 3 hours respectively, expressed in thousandths of a milligramme per 100 sq. cm.:—

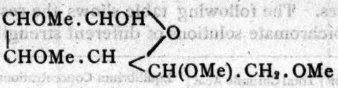
Classes of Glass.	Alkali dissolved by	
	Water at 18°.	Water at 80°.
A Quartz	—	—
B Non-hydrolytic glasses (example Jena Glass 59^{III})	0–4	0–15
C Water-resisting glasses (example Stass' glass)	4–12	15–45
D Harder apparatus glasses (example Jena thermometer glass 16^{III})	12–36	45–150
E Softer apparatus glass (example flint glass)	36–150	150–600
F Defective glasses	over 150	over 600

It will be seen that the higher members of this scale are also the least fusible and most costly glasses. W. Ros.

427. *Stereoisomeric Tetramethyl Methylglucosides and Tetramethyl Glucose.* **T. Purdie** and **J. C. Irvine.** (Chem. Soc., Journ. 85. pp. 1049–1070, July, 1904.)—Tetramethylglucose—

$$\mathrm{CHO\,.\,[CH(OMe)]_2\,.\,CH(OH)\,.\,CH(OMe)\,.\,CH_2\,.\,OMe}$$

or more probably—



resembles glucose in that it exhibits the phenomena of mutarotation. Unlike glucose, it is soluble in liquids such as benzene and carbon tetrachloride, and exhibits mutarotation in these liquids as well as in water and alcohol.

The α-form, melting at 88–89°, gave $[\alpha]_D + 100{\cdot}8°$, falling within 24 hours to $+ 83{\cdot}3°$ in aqueous solution. In benzene the values were $[\alpha]_D + 111°$ to $+ 84{\cdot}6°$, whilst the final values in other solvents were alcohol 83·1°, toluene 84·1°, carbon tetrachloride 81·6°. The stable mixture of sugars recovered from benzene solution exhibited no mutarotation when dissolved in other solvents, and the conditions of equilibrium are probably the same in each solvent. By heating the sugar at 115–120° a mixture was obtained which contained an excess of the β-form and showed an increase of rotatory power in freshly-prepared solutions. The minimum value observed was 73·1° in water, 73·5° in alcohol, and 76·3° in benzene. T. M. L.

428. *Hypochlorous Acid.* I. **W. Nernst** and **J. Sand.** II. **J. Sand.** (Zeitschr. Phys. Chem. 48. pp. 601–609, and pp. 610–614, July 1, 1904. Inst. für physikal. Chemie, Göttingen.)—I. The electromotive force of a hypochlorous-acid | hydrogen cell with platinum electrodes is 1·485 volts according to Müller. The electromotive force can be calculated both for hypochlorous acid and its salts by using Jakowkin's observations on the equilibrium between chlorine and water—

$$\mathrm{H_2O + Cl_2 \rightleftharpoons 2HClO.}$$

A good agreement is found in the case of solutions which contain a fair proportion of free hypochlorous acid. At lower concentrations the electrode is probably charged only with oxygen produced by the decomposition of the acid. II. The strength of hypochlorous acid cannot be determined by conductivity measurements on account of the instability of the acid, but was arrived at by putting the acid into competition with carbonic acid. The method was to determine the difference between the solubility of carbon dioxide in water and in a neutral solution of sodium hypochlorite; the difference was taken to represent the amount of carbon dioxide absorbed as bicarbonate by the base. The dissociation constant deduced in this way was $K = 3{\cdot}7 \times 10^{-8}$ at 17° C., as compared with $K = 3{\cdot}04 \times 10^{-7}$ for carbonic acid.

T. M. L.

429. *Chromate, Bichromate, and Chromic Acid.* **R. Abegg** and **A. J. Cox.** (Zeitschr. Phys. Chem. 48. pp. 725–734, July 12, 1904. Anorg. u. physik. chem. Abt. des chem. Universitätslaborat., Breslau, 1904.)—The interaction between chromic acid and a neutral chromate to form a bichromate is incomplete and reversible $K_2CrO_4 + CrO_3 \rightleftarrows K_2Cr_2O_7$ as shown by the fact that neutral chromates of barium, silver, &c., are precipitated on adding a bichromate to a salt of the metal. In order to determine the amount of free chromic acid in the solutions, advantage was taken of the fact that mercuric chromate is hydrolysed to a sparingly soluble basic salt and free chromic acid until the concentration of chromic acid reaches a definite value $2HgCrO_4 = HgCrO_4, HgO + CrO_3$, where at 50° $CrO_3 = 0{\cdot}706$ molar; at 25° $CrO_3 = 0{\cdot}456$ molar. The concentration of chromic acid in a saturated solution of potassium bichromate is less than this, since chromic acid passes into the solution when it is shaken with a mixture of neutral and basic mercuric chromates. The following table shows the results obtained in this way when using bichromate solutions of different strengths:—

	Concentration of $K_2Cr_2O_7$ (K)	Total Chromic Acid in Equilibrium C	Equilibrium Concentrations.			$K = \frac{Cr_2O_7'')}{(CrO_3).(CrO_4'')}$	
			(CrO_3)	(CrO_4'')	(Cr_2O_7'')		
50°	2·0	2·11	0·706	0·596	0·404	0·96	Mean, 0·96
	1·5	1·71	,,	0·496	0·254	0·73	
	1·13	1·495	,,	0·341	0·224	0·93	
	1·0	1·44	,,	0·266	0·234	1·25	
	0·1	0·776	,,	0·030	0·020	0·94	
25°	1·13	1·204	0·456	0·382	0·183	1·05	Mean, 1·08
	1·0	1·15	,,	0·306	0·194	1·39	
	0·6	0·848	,,	0·208	0·092	1·97	
	0·5	0·782	,,	0·174	0·076	0·96	
	0·1	0·522	,,	0·034	0·016	1·03	

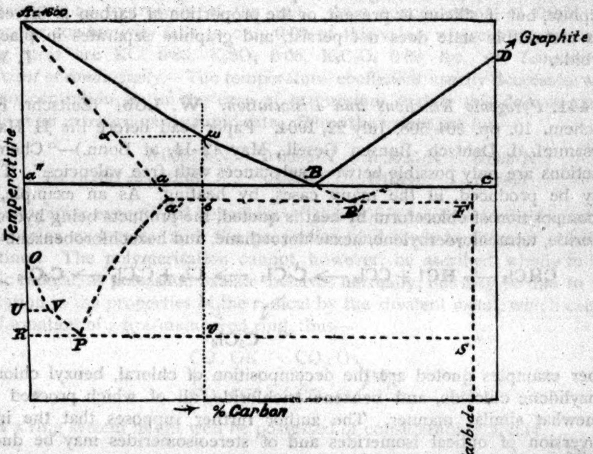
It will be noticed that the tendency to form bichromate decreases as the temperature rises, and that a bichromate when heated will, therefore, dissociate into chromate and chromic acid; the heat of dissociation deduced by means of van't Hoff's formula from the equilibrium at 25° and 50° is 800 cals. The degree of dissociation x of bichromate solutions of concentration c is as follows:—

$c =$	1	0·25	0·1	0·01	0·001
$x =$	0·62	0·83	0·91	0·99	1

From which it is seen that even at the highest concentrations the greater part of the bichromate is dissociated into chromate and chromic acid. Confirmation of these values is found in the freezing-points and in the electrical conductivity of the solutions.

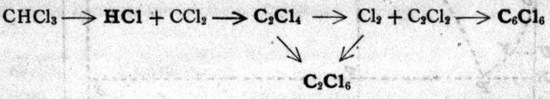
T. M. L.

430. *Labile and Metastable Equilibrium in Iron-Carbon Alloys.* **E. Heyn.** (Zeitschr. Elektrochem. 10. pp. 491–503; Discussion, pp. 503–504, July 22, 1904. Paper read before the 11 Hauptversamml. d. Deutsch. Bunsen Gesell. May 12–14, at Bonn.)—The application of the phase-rule to the iron-carbon alloys leads primarily to results which can be used only in those cases in which a condition of stable equilibrium is reached, *i.e.*, when the metal is very carefully annealed. If it were possible to quench the metal sufficiently quickly, the structure of the alloy as it exists at the high temperature might be preserved indefinitely (though in a condition of labile equilibrium) at atmospheric temperatures. Experience has proved, however, that in the case of these alloys "complete overcooling" is never attained, and the quenched metal always possesses a structure intermediate between that which is stable at the temperature of quenching and that which is stable at atmospheric temperatures. The change of structure occurs between Ar_3 and Ar_1, *i.e.*, in the case of pure iron between 900° and 700°, in the case of iron with 0·95 per cent. C, at 700°, and in the case of iron with, *e.g.*, 1·2 per cent. C, between 900° and 700°. The treatment of the iron above these temperatures has little influence on its structure, which is mainly determined by the treatment between the highest transition-temperature Ar_3 and 700°. The extent to which the mixed iron and carbon crystals of martensite break up depends largely on the magnitude of this critical interval of temperature. The alloy with 0·95 per cent. C has least tendency to become resolved into its constituents, whilst alloys with carbon-content differing considerably from this show an increasing proportion of either free ferrite or free cementite when quenched under identical conditions. This separation of the martensite into its constituents is compared with the devitrification of glass. Troostite, which differs from martensite mainly in that it appears black instead of grey, is probably an intermediate stage in the resolution of martensite into its constituents. Its formation is hindered by the presence of manganese, and the quantity formed decreases as the temperature of quenching is raised. It was supposed by Roberts-Austen and by Roozeboom that above 1,000° carbon



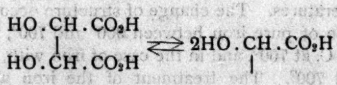
crystallised from iron in the form of graphite, whilst below this temperature cementite, Fe_3C, was the stable form. This view is not easily reconciled with the fact that graphite is not found in steel quenched above 1,000°, and is directly contradictory to the well-known fact that rapid cooling gives a white iron free from graphite, whilst slow cooling favours the formation of graphite. To overcome this difficulty a scheme shown in the Fig. is suggested. This scheme is based on the view that graphite is always the stable, and cementite the labile, form of carbon, but that the conversion of cementite into graphite is relatively slow, especially at lower temperatures. Experimental justification is found in the well-known fact that a white cast-iron, free from graphite, separates graphitic carbon (tempering carbon) when long heated. In the Fig. the full lines show the stable equilibrium between iron and graphite, the dotted lines the metastable equilibrium between iron and carbide. Iron containing 3·5 to 4 per cent. C deposits only carbide and no graphite, but if silicon is present, or the proportion of carbon is increased, this metastable state does not persist, and graphite separates in place of carbide. T. M. L.

431. *Pyrogenic Reactions and Dissociation.* **W. Löb.** (Zeitschr. Elektrochem. 10. pp. 504–508, July 22, 1904. Paper read before the 11 Hauptversamml. d. Deutsch. Bunsen Gesell., May 12–14, at Bonn.)—"Chemical reactions are only possible between substances with free valencies." These may be produced, in the many cases, by heating. As an example, the decomposition of chloroform by heat is quoted, the products being hydrogen chloride, tetrachloroethylene, hexachloroethane, and hexachlorobenzene—



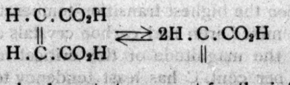
$$\begin{tikzcd} CHCl_3 \arrow[r] & \mathbf{HCl} + CCl_2 \arrow[r] & \mathbf{C_2Cl_4} \arrow[r] \arrow[dr] & Cl_2 + C_2Cl_2 \arrow[r] \arrow[d] & \mathbf{C_6Cl_6} \\ & & & \mathbf{C_2Cl_6} & \end{tikzcd}$$

Other examples quoted are the decomposition of chloral, benzyl chloride, benzylidene chloride, and benzene trichloride, all of which proceed in a somewhat similar manner. The author further supposes that the interconversion of optical isomerides and of stereoisomerides may be due to dissociation, *e.g.*, in the case of tartaric acid—



$$\begin{array}{l} HO.CH.CO_2H \\ \quad | \\ HO.CH.CO_2H \end{array} \rightleftarrows 2HO.\underset{|}{CH}.CO_2H$$

and in the case of maleic acid—



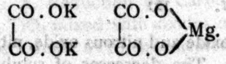
$$\begin{array}{l} H.C.CO_2H \\ \quad \| \\ H.C.CO_2H \end{array} \rightleftarrows 2H.\underset{\|}{C}.CO_2H$$

This theory is, however, inadequate to account for the influence in preventing isomeric change of a methyl group substituted for a hydrogen atom in many of these compounds, and is not supported by any experimental data. The view that "valency depends on experimental conditions," and decreases as the temperature rises, affords an alternative method of describing the phenomena of dissociation. [See also Abstract No. 675 (1904).] T. M. L.

432. *Aqueous Solutions of Magnesium Oxalate.* **F. Kohlrausch** and **F. Mylius.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 40. pp. 1223–1227, July 28, 1904.)—In determining the solubility of magnesium oxalate it was found (1) that saturation equilibrium, either from above or below, was very slowly attained ; (2) that the temperature coefficient of electrical conductivity was remarkably small ; and (3) that the equivalent-conductivity decreased remarkably rapidly with increasing concentration. (1) *Supersaturation.*—The solubility of magnesium oxalate, $MgC_2O_4 . 2H_2O$, is 0·0053 gm. equiv. per litre, or about $\frac{1}{30}$ per cent., but a 10 per cent. solution can be prepared by dissolving magnesium hydroxide in oxalic acid at 0° C. The concentration gradually decreased when the solution was kept, but even at the end of a fortnight the concentration was $1\frac{1}{2}$ times as great as that required to saturate the solution. Warming facilitates the separation of the oxalate from the solution, and stirring produces a similar, but not very marked, effect. (2) *Conductivity.*—The equivalent conductivity for infinite dilution should be $\Lambda_0 = 110$; this value is not reached at a dilution of N/40,000, or 1·5 mgm. per litre, and there is therefore no hydrolysis of the salt. At a concentration of 0·2-N the molecular conductivity falls to only 0·09 of this value, whereas the ratios in other cases are KCl 0·83, K_2SO_4 0·66, $K_2C_2O_4$ 0·69, &c. (3) *Temperature coefficient of conductivity.*—The temperature coefficient usually decreases with the concentration, but in the case of magnesium oxalate this decrease proceeds at an extraordinarily rapid rate. Thus the values are for—

	0·00015-N	0·0005-N	0·0025-N	0·033-N
$1/x . dx/dt =$	0·0236	0·0228	0·0288	0·0203

The altogether exceptional behaviour of this salt is ascribed to the formation of complex molecules, and the properties tend towards those of colloidal solutions. The polymerisation cannot, however, be ascribed wholly to the oxalic radical, as potassium oxalate behaves normally, but may be due to the alteration in the properties of the radical by the divalent metal, which causes the formation of a five-membered ring, thus—



Such a ring system might well be possessed of considerable stability.

T. M. L.

433. *Molecular State of Anhydrous and Hydrated Metallic Salts in Organic Solvents.* **G. Bruni** and **A. Manuelli.** (Zeitschr. Elektrochem. 10. pp. 601–604, Aug. 12, 1904. Allgem. chem. Laborat. der Univ., Bologna.)—A summary is given of previous work on the subject. By means of cryoscopic observations it is shown that the chlorides of manganese, cobalt, and copper, when dissolved in urethane, have the simple formulæ $MnCl_2$, $CoCl_2$, and $CuCl_2$, and the hydrated chlorides retain a part of their water of crystallisation. Acetamide has a dielectric constant >84, which is greater than that of water. In this solvent potassium iodide appears to be completely dissociated, and the chlorides of manganese, cobalt, and copper partially so. The chlorides $MnCl_2 . 4H_2O$, $COCl_2 . 6H_2O$, and $NiCl_2 . 6H_2O$, lose the whole of their water of crystallisation when dissolved in acetamide. T. M. L.

434. *Recognition of Tautomerism in Liquids.* **R. Schenck** and **E. Ellenberger.** (Ber. Deut. Chem. Gesell. 37. pp. 3443–3453, Sept. 24, 1904.)—The curve connecting the molecular surface energy $\left\{\gamma(Mv)^{2/3}\right\}$ of a liquid with the temperature is a straight line for a pure liquid, and for the two distinct modifications of a tautomeric liquid two parallel straight lines would be obtained; for a mixture of the two forms which changes in composition with the temperature a curve would be obtained. The value of the temperature coefficient, k, of the molecular surface energy may be calculated from the equation: $\gamma(Mv)^{2/3} = k(\tau - t - d)$, where τ is the critical temperature, t that of observation, and d the correction factor for 5°. For a normal liquid the value of this temperature coefficient is 2·12 ergs, but for a liquid exhibiting tautomerism the value first approximates to the normal, then reaches a maximum or a minimum, and finally again approximates to the normal value. Changes due to tautomerism can be distinguished from those due to association by determining the values of k at sufficiently low temperatures, as, in cases of association the coefficient goes on decreasing with the temperature. The results obtained in this way with fused dibenzoylacetone, acetylacetone, and ethyl acetoacetate, confirm those obtained by other observers. T. H. P.

435. *Solubility* [*of Gases in Aqueous Solutions*]. **G. Geffcken.** (Zeitschr. Phys. Chem. 49. pp. 257–302, Aug. 30, 1904. Physikal.-chemisches Institut, Leipzig, March, 1904.)—Experiments are described on the influence on the solubility of hydrogen in water at 25°, of acetic, chloracetic, nitric, hydrochloric, and sulphuric acid, and sodium and potassium hydroxides. The largest effect is produced by the alkalies, which lower the solubility of the gas to almost equal extents when added in equivalent quantities. Similar effects are produced in the case of oxygen gas at 25° and 15°. The decrease of solubility per cent. by the addition of one equivalent of solute is as follows:—

	H_2 at 25°.	O_2 at 25°.	O_2 at 15°.		H_2 at 25°.	O_2 at 25°.	O_2 at 15°.
CH_3CO_2H	1	—	—	KOH	26·4	33·1	28·4
$CH_2Cl.Cl_2H$...	3·4	—	—	NaOH......	27·9	33·8	34·7
HNO_3............	4·9	4	7·4	NaCl	—	27·6	35·5
HCl	7·0	6·8	8·9	$\frac{1}{2}K_2SO_4$ ...	—	32·8	36·4
$\frac{1}{2}H_2SO_4$	8·1	10·7	12·1				

In the case of carbon dioxide and nitrous oxide, nitric acid actually produces an increase of solubility. The decreases of solubility per cent. for normal solutions are as follows:—

	CO_2 at 25°.	CO_2 at 15°.	N_2O at 25	N_2O at 15°.
HNO_3	− 4	− 1·5	− 1	0
HCl	+ 3·3	+ 3·9	+ 4·4	+ 5·1
$\frac{1}{2}H_2SO_4$	6·8	8·6	8·7	10·2
NH_4Cl........................	—	—	10·9	11·2
KNO_3	9·6	11·7	—	—
KI........................	12·0	13·7	17·2	18·6
RbCl	13·1	13·9	18·7	—
KBr........................	13·7	14·6	18·3	19·4
KCl	15·2	16·2	20·0	20·6
KOH	—	—	26·6	28·1

Colloids produce practically no change in the solvent properties of water. Measurements of electrical conductivity showed that nitrous oxide in aqueous solutions behaves as a neutral substance, and is not converted into hyponitrous acid. T. M. L.

436. *Transport Values in Electrolysis of a Mixture of two Fused Salts.* **R. Lorenz and G. Fausti.** (Zeitschr. Elektrochem. 10. pp. 630–633, Aug. 19, 1904. Communication from the Elektrochem. Laborat. des eidgen. Polytechnikums, Zürich.)—The electrolyte was a mixture of lead chloride with fused potassium or sodium chloride, and was heated to constant temperature in an electric oven. Preliminary experiments showed that the concentration of the lead salt in the neighbourhood of the kathode was decreased by electrolysis, and that the concentration of the potassium salt was increased. Quantitative measurements in the case of a mixture of the composition $PbCl_2 . KCl$ gave discordant results for the transport value of the potassium, namely, 0·36 and 0·19, but it appears probable that the value is much smaller than in aqueous solutions, and the author is of opinion that in addition to a complex anion containing lead, the fused salt contains a complex kathion in which the potassium ion is linked with potassium chloride. T. M. L.

437. *Asymmetric Synthesis.* I. *Reduction of Menthyl Benzoylformate.* II. *Action of Magnesium Alkyl Halides on Menthyl Benzoylformate.* **A. McKenzie.** (Chem. Soc., Journ. 85. pp. 1249–1262, Sept., 1904.)—An attempt was made to prepare an active mandelic acid by reducing the active menthyl ester, $C_6H_5 . CO . CO_2 . C_{10}H_{19}$, of inactive benzoylformic acid, $C_6H_5 . CO . CO_2H$. The reduced ester, $C_6H_5 . CHOH . CO_2 . C_{10}H_{19}$, appeared to contain an excess of the ester of *l*-mandelic acid, but an active acid could not be separated from it as the acid undergoes inversion during hydrolysis. When, however, the acid was combined by means of magnesium methiodide with the radicals CH_3 and H to form the homologous ester $C_6H_5 . CMe(OH) . CO_2 . C_{10}H_{19}$, the presence of the methyl group was sufficient to prevent inversion during the hydrolysis and an active phenyl methylglycollic acid, $C_6H_5 . CMe(OH) . CO_2H$ was produced. T. M. L.

438. *Titanium and Titanium Alloys.* **W. Huppertz.** (Metallurgie, 1. pp. 362–366, Sept. 8; 382–385, Sept. 22; 404–417, Oct. 8; 458–462, Nov. 8; and pp. 491–504, Nov. 22, 1904. Communication from the Aachener Institut für Metallhüttenwesen und Elektrometallurgie.)—A long account of the winning of titanium and titanium alloys by the aid of the electric furnace. The research comprises: A. Reduction by Carbon. I. Reduction of TiO_2 alone. II. Reduction of TiO_2 mixed with oxides of easily vaporised metals. For example, a mixture of $1MnO_2$, $4TiO_2$ was heated in an arc furnace with a current of 90 amps. at 25 volts for 20 min. Other mixtures included $Al_2O_3 + TiO_2$ and $CuO + TiO_2$. The use of the arc furnace leading to complications, a graphite crucible of 200 c.cm. with a resistance rod of carbon 80 mm. long and 10 mm. thick was substituted. A current of 270 amps. at 18 volts was employed. In this resistance furnace K_2O, Na_2O, $2TiO_2$; CaO, TiO_2; Al_2O_3, $3TiO_2$; MnO, TiO_2; ZnO, TiO_2; and CuO, TiO_2 were heated and the products analysed. Further experiments were made with a specially designed arc furnace fed with 400 amps. and 45 volts, in which the crucible was placed within a block of magnesite. Another type of arc furnace was used in which the reduction was carried on in an atmosphere of hydrogen. III. Reduction of TiO_2 and an oxide of a difficultly-vaporised metal. The mixtures included Cr_2O_3, $3TiO_2$ and WO_3, $3TiO_2$. B. Reduction by calcium carbide. C. Reduction by aluminium. D. Reduction by electrolysis. The apparatus was that of Borchers and Stockem, which they used for the separation of strontium from strontium chloride. A mixture of $CaCl_2$ and TiO_2 was submitted to electrolysis. Methods of refining the products are described.

W. W. H. G.

439. *Theories of Osmosis, Solubility, and Narcosis.* **I. Traube.** (Chem. News, 90. pp. 157–158, Sept. 23, 1904. Abstract of paper read before the British Association at Cambridge. Deutsch. Phys. Gesell. Verh. 6. 22.

pp. 326–331, Nov. 30, 1904. Phil. Mag. 8. pp. 704–715, Dec., 1904.)—Overton has suggested that the magnitude of the distribution coefficient of a narcotic between water on the one hand, and fat, cholesterins, and lecithins on the other, determines the velocity of osmosis of the narcotic into the protoplast. It is now shown that, at least in the case of aqueous solutions, there is an exact relationship between the velocity of osmosis of a liquid and its capillarity constant; thus substances which cannot penetrate membranes raise the capillarity constants of water, but substances which penetrate rapidly lower the constant. From this parallelism between osmotic velocity and surface tension it is suggested that the difference of surface tension (or of internal pressure) is the motive force in osmotic phenomena. According to this theory it is not the salt which in virtue of its "osmotic pressure" diffuses into the pure solvent, but the pure solvent which in virtue of its low surface tension diffuses into the salt solution. T. M. L.

440. *Addition of Bromine to Carbon Atoms United by a Double Linking.* **H. Bauer.** (Ber. Deut. Chem. Gesell. 37. pp. 3317–3321, Sept. 24, 1904.)—Concerning the addition of bromine to unsaturated compounds in diffused daylight, the following conclusions are arrived at by the author: To the system $CO_2H . CH : CH_2$, bromine is added as long as all the three hydrogen atoms are not replaced by bromine or by bromine together with methyl; with three methyl groups, the ability to take up bromine persists. With two carboxyl groups, as in $CO_2H . CH : CH . CO_2H$, addition of bromine takes place so long as the two hydrogen atoms are not substituted by bromine or methyl. Thus dimethylfumaric, dibromofumaric, and bromomesaconic acids do not form dibromides. Ethylenetetracarboxylic acid and tetraphenylethylene do not combine with bromine. With styrene, $C_6H_5 . CH : CH_2$, the substitution of the three hydrogen atoms by methyl does not destroy the power to combine with bromine, but with stilbene, $C_6H_5 . CH : CH . C_6H_5$, when the two hydrogens are replaced by bromine, no further quantity of the latter can be taken up. The addition of bromine to $CH_2 : C(C_6H_5)_2$ is prevented by replacing one hydrogen atom by bromine, but is not interfered with by introducing one or two methyl groups in place of the hydrogen.
T. H. P.

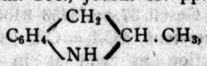
441. *Constitution of Ethyl Acetoacetate.* **L. Knorr.** (Ber. Deut. Chem. Gesell. 37. pp. 3488–3489, Sept. 24, 1904.)—The results obtained by Knorr and Hörlein [see next Abstract] indicate that the fact of ethyl acetoacetate not answering to Hantzsch's ammonia reaction is not a proof that the enolic modification is absent. The author states that his former conclusion, that, in ethyl acetoacetate, the enolic and ketonic forms are present in a condition of equilibrium, is probably correct. T. H. P.

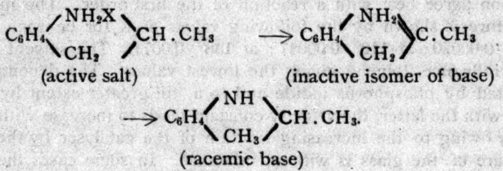
442. *Hantzsch's Ammonia Reaction and the Enolic Forms of Ethyl Diacetylsuccinate.* **L. Knorr** and **H. Hörlein.** (Ber. Deut. Chem. Gesell. 37. pp. 3490–3493, Sept. 24, 1904.)—None of the seven known modifications of ethyl diacetylsuccinate, five of which are enolic in structure, give precipitates with ammonia in ethereal solution. A solution of the β-compound in ether, after heating to 120°, gives with ammonia an amorphous precipitate of ammonium ethyl isocarbopyrotritarate; it is, however, known that the ethyl ester of this acid is formed on heating ethyl diacetylsuccinate, and, after the removal of the precipitated ammonium ester, the ethereal filtrate gives no further precipitate with ammonia, although it still contains a considerable amount of the enolic compound. The statement made by

Hantzsch and Dollfus to the effect that the enolic modifications of ethyl diacetylsuccinate yield precipitates with ammonia in ethereal solution is hence inaccurate, the precipitates being due to the presence of acid impurities in the esters employed. This ammonia reaction is, therefore, not a certain means of distinguishing between ketonic and enolic compounds, but may be used to discriminate between strongly enolic compounds and those only weakly so. T. H. P.

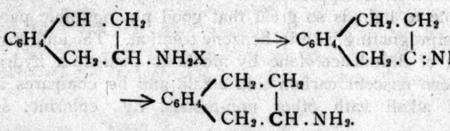
443. *Decomposition of Di-iodoacetylene.* **R. Schenck and J. Litzendorff.** (Ber. Deut. Chem. Gesell. 37. pp. 3453–3464, Sept. 24, 1904.)—The decomposition of di-iodoacetylene, $2C_2I_2 = C_2I_4 + C_2$, takes place with measurable velocities in solution as well as in the solid state. The reaction, $C_2I_4 = C_2I_2 + I_2$, is reversible, and proceeds from left to right under the influence of light, as well as of heat; in benzene solution equilibrium is reached when 4 per cent. of the tetra-iodoethylene is decomposed. Heating to 50° effects no decomposition of ethylene bromide, but the influence of light is very powerful; at 138° 8·8 per cent. of the tetra-iodo-compound is dissociated. The velocity constants of the decomposition of di-iodoacetylene in solution agree best with a reaction of the first order. The influence of temperature is shown by the following values of K for benzene solutions: At 100°, 0·00020; at 110°, 0·00047; at 138°, 0·0071. The solvent has a less marked influence, toluene giving the lowest values. The decomposition is accelerated by phosphorus iodide and to a still greater extent by mercuric iodide; with the latter, the velocity constant tends to increase with the time, probably owing to the increasing solution of the catalyser by the benzene. The nature of the glass is without influence. In some cases the solutions remain clear for hours at 100°, the deposition of carbon then occurring suddenly and a considerable amount of decomposition then rapidly taking place; the carbon hence appears to act as a catalyser. The sensitiveness of di-iodoacetylene to light is so great that good photographic paper may be prepared by impregnating with its benzene solution. The author regards the decomposition of di-iodoacetylene by alcoholic potassium hydroxide as a reaction between nascent carbon and alkali, and he compares it with the interaction of alkali with other non-metals, *e.g.*, chlorine, sulphur, or phosphorus. T. H. P.

444. *Reciprocal Solubility of Oil of Turpentine and Aqueous Alcohol.* **M. Vèzes and Mouline.** (Bull. Soc. Chim. 31. 3. pp. 1043–1049, Oct. 5, 1904.)—Oil of turpentine is miscible in all proportions with absolute alcohol over a wide range of temperature, which is, however, greatly narrowed when aqueous alcohol is used in place of the pure spirit. The temperature at which any mixture separates into two layers depends on the relative proportion of turpentine oil and on the composition of the aqueous alcohol, and varies also with the pressure. The curves of separation obtained by plotting as ordinates values of the mass of aqueous alcohol (z) in unit mass of each of a series of mixtures, and as abscissæ, the temperatures of separation, are similar to those usually given by binary mixtures, the temperature rising to a maximum and then falling as the concentration of the alcohol is increased. The curves are not symmetrical, but as a whole lie nearer to the terminal line $z = 0$ (turpentine oil) than to $z = 1$ (aqueous alcohol). The curves show that (1) the separation temperature rises as the concentration of water, relatively to the alcohol, is increased; (2) the solubility of aqueous alcohol in turpentine oil is greatly inferior to that of the oil in the aqueous alcohol at the same temperature; and (3) the method which has been proposed for identifying fats by means of their critical solution temperatures cannot be generally applicable, since this is not practically independent of the concentration. The isothermal separation curves for temperatures of — 20°, 0°, + 20°, and + 40° and aqueous alcohol varying in strength from 90 to 97 per cent., are also unsymmetrical. T. H. P.

445. *Resolution of Externally Compensated Dihydro-α-Methylindole.* **W. J. Pope** and **G. Clarke, Jr.** (Chem. Soc., Journ. 85. pp. 1330–1339, Oct., 1904.)—The base has the formula  and was resolved by means of *d*-bromocamphorsulphonic acid. In addition to the two salts *d*B*d*A and *l*B*d*A, normally produced, a third salt was isolated, which had a specific rotatory power much lower than that of the *d*-bromocamphor sulphonate, thus suggesting that the salt contained a lævorotatory base. The base liberated by means of alkalies was, however, found to be inactive. It is suggested that racemisation may occur during the hydrolysis of the salt



This explanation is similar to that given of the partial racemisation of tetrahydro-β-naphthylamine when liberated from its salts



T. M. L.

446. *Influence of Non-electrolytes on the Vapour Pressure of Acetic Acid in Solution.* **P. Bogdan.** (Annales Scientifiques de l'Univ. de Jassy, 2. pp. 302–327, Oct., 1903; and 3. pp. 35–77, Nov., 1904.)—The author's investigations are based on the fact that the distribution of a substance A between two non-miscible liquids B and C is changed by the addition of a fourth substance D, which is only soluble in one of the layers (and consequently only alters the vapour pressure of the dissolved substance in this layer), until the vapour pressures of the two layers have again become equal. Different cases present themselves according as association of the molecules does or does not take place in one of the solutions, and these are treated mathematically by the author. In the experiments described one of the liquids (B) is always water, the other (C) benzene or *iso*amyl acetate, and the dissolved substance (A) acetic acid; the influence of the fourth substance (D) is in general that effected by changing the acidity of the aqueous layer, this being easily measurable and giving readily the relative molecular lowering of the solubility. The most important of the numerous results obtained are as follows: The molecular depression of the solubility is constant for a given substance D below a certain concentration, the values being 8·5 for ether, 8·7 for ethyl acetate, 8·3 for *iso*butyl acetate, 8·0 for *iso*amyl acetate, 0·88 for nitrobenzene, 0·28 for chloroform, 0·14 for toluene, and 0·14 for ethylene bromide. It is found that the values of these depressions run parallel with those of the molecular solubilities, although there is no quantitative relation between the two sets of values. Foreign substances which lower the vapour pressure of a dissolved substance raise its solubility. From the solubility determinations, as also from cryoscopic investigations of liquid mixtures, it follows that, in general, reciprocal solubility of two substances corresponds with an association of their molecules and that solutions are therefore formed by the association of the molecules of the dissolved substance and of the solvent. Solutions must hence be regarded as chemical compounds of the solvent and solute. The author develops a new theory of solutions on a kinetic basis. In a solvent there exists a mobile equilibrium between simple and polymeric molecules. In dilute solutions, the dissolved molecules are almost completely associated with those of the solvent, while in more concentrated solutions, the molecules of the dissolved substance may be associated among themselves, so that a fraction of the whole number, increasing with the concentration, remains inactive. The union between the separate molecules is generally a loose one. To explain the phenomena in the case of electrolytes it is not sufficient, as in the older hydrate theory, to assume the association of a dissolved molecule with two of the solvent, but the electrolytes must be regarded as dissociated, the ions being associated with the solvent. From this theory the author develops mathematically the laws holding for dilute and moderately concentrated solutions. T. H. P.

447. *Colloidal Precipitation on Aluminium Electrodes.* **W. R. Mott.** (Electrochem. Ind., N.Y. 2. pp. 444–447, Nov., 1904.)—The mode of formation of the insulating film on aluminium is considered in the light of the general phenomena of colloidal precipitation. Solutions of chromates, phosphates, tartrates, &c., strongly precipitate colloidal $Al_2H_6O_6$. The same electrolytes produce insulating films on Al anodes having absorptive properties similar to those observed in colloidal precipitation. These facts suggest that film formation at an Al anode and colloidal precipitation are allied phenomena. The composition of the film is discussed. The rival theories regard this as (1) a sub-oxide of aluminium, (2) oxide (Al_2O_3) of aluminium, (3) hydrate of aluminium, and (4) a basic aluminium salt. The history of these theories is given, and the conclusion is reached that the insulating film consists of aluminium hydrates combined with basic salts of aluminium. The opinion has been advanced by Wilson and Norden that $Al_2H_6O_6$ is first formed and then this reacts with the electrolyte to take up the acid radical. Taylor and Inglis (Phil. Mag. 5. pp. 301–313, March, 1903) have shown that a film of hydroxide can be substituted for the metal anode. They deposited the hydroxide in the walls of a porous cup and then with this membrane between Pt electrodes they reproduced the peculiarities of the Al anode. It is concluded that aluminium hydroxide is first produced on the Al anode and this reacts with the electrolyte. The phenomenon of taking up the acid radical is called "*adsorption*." $Al_2H_6O_6$ as precipitated by ammonia from a chloride solution is in a loose and flocculent form, easily soluble, but when left standing for a long time in contact with sulphate solutions it becomes more and more insoluble in acids and even alkalies. This slow chemical process takes place with great rapidity at an Al anode. The loose hydroxide is there compacted into a dense, very hard, insoluble film of great specific resistance and high dielectric strength. The *solidifying* effect of different electrolytes is next considered in detail. Citric acid, which is trivalent, has extreme precipitating power, and films formed in citrates at 20 volts are much thinner than those formed in sulphates. Generally electrolytes containing *acid radicals of high valency* give high critical voltages and films of great specific resistance and high dielectric strength, and so thinner films are obtained requiring less coulombs for their formation. [See also Abstracts Nos. 2174B and 3259 (1904), and 175 and 177 (1905).] W. W. H. G.

448. *Decomposition of Methylcarbamide.* **C. E. Fawsitt.** (Chem. Soc., Journ. 85. pp. 1581–1591, Nov., 1904.)—An extension of the author's work on carbamide [see Abstract No. 515 (1903)] to methylcarbamide shows that the latter in its decomposition on treatment with acids, alkalies, or water alone, behaves very similarly to carbamide. By acids it is converted first into methylamine cyanate, which is then decomposed, the reaction being of the first order, while when treated with concentrated alkali, in addition to the indirect decomposition, some direct hydrolysis also occurs. Determinations of the rate of reaction, by titrating the solution, if acid, with standard barium hydroxide, or when alkaline, by opening the tubes below the surface of a known excess of acid, and then titrating the acid remaining, with barium hydroxide, establish the equilibrium $\frac{C_{CON_2H_3.CH_3} \times C_{HCl}}{C_{CON_2H_3.CH_3, HCl}} = K$, where C represents the concentration of the substance and K is a constant. Change in the concentration of the methylcarbamide, or, within certain limits, of the acid, does not appreciably affect the velocity constant, but very highly concentrated acid diminishes the rate of reaction considerably. With sulphuric acid the velocity coefficient is smaller than with hydrochloric acid, and in all cases the reaction is slower than with carbamide. W. H. Si.

449. *Liquid Crystals.* **A. Coehn.** (Zeitschr. Elektrochem. 10. pp. 856–857, Nov. 4, 1904. Inst. für physikal. Chemie, Göttingen, Sept., 1904.)—Attempts have frequently been made to prove that "liquid crystals" are non-homogeneous systems, or emulsions of some impurity which at a higher temperature dissolves in the substance which forms the chief constituent of the liquid. Two further attempts are now described which have again led to negative results: (1) An attempt was made to detect the phenomenon of kataphorosis. The liquid *p*-azoxyanisole was arranged in a U-tube heated so that the upper part of the liquid was clear, the lower part turbid. An e.m.f. of 440 volts was applied, but no motion of the boundary between turbid and clear liquid could be detected. (2) A specimen of *p*-azoxyanisole was kept during 5 hours at 125° in a centrifugal machine rotating at 1,000 r.p.m., but the transition temperature was found to be quite unaltered, and no sign of separation into two layers could be seen. T. M. L.

450. *Stannichlorides of the Types* $M_2'SnCl_6$ *and* $M''SnCl_6$. II. **E. v. Biron.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 36. pp. 933–947, 1904.)—On repeating the experiments of Engel, the author obtains tin meta- and para-chlorides having properties identical with the products obtained by Engel. The meta-chloride differs slightly in composition from that prepared by this author. From the results obtained, together with those of other investigators, the following conclusions are drawn: When *α*-stannic acid undergoes change, it yields an uninterrupted series of varieties of *β*-stannic acid, differing as

regards their degree of condensation, which becomes greater as the temperature rises. The action of hydrochloric acid on these various β-stannic acids gives rise to oxychlorides which have an indefinite composition and contain a larger or smaller proportion of chlorine according as the condensation of the β-acid is small or great. The oxychlorides, differing considerably in composition, exhibit differences in properties similar to those shown by the tin meta- and para-chlorides of Engel. The reverse reactions, by which the oxychlorides are converted into a derivative of the α-acid, namely, stannic chloride, proceed the more readily the less the condensation. T. H. P.

451. *Equilibrium of the same Reaction in Different Solvents.* **L. Pissarjewsky.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 36. pp. 1070–1081, 1904.) —The equilibrium constant of the reaction—

$$2\mathrm{KCl} + \mathrm{Hg_2SO_4} \rightleftarrows \mathrm{Hg_2Cl_2} + \mathrm{K_2SO_4}$$

has the same value whether the solvent is water, 20 per cent. aqueous alcohol, or 61·5 per cent. aqueous glycerol. The temperature coefficient (between 25° and 44·2°) of the e.m.f. of the element—

$$\mathrm{Hg}\,\Big|\,\frac{0{\cdot}01n-\mathrm{KCl},\ \mathrm{Hg_2Cl_2}}{n-\mathrm{KNO_3}}\,\Big|\,n-\mathrm{KNO_3}\,\Big|\,\frac{\mathrm{Hg_2SO_4},\ 0{\cdot}01n-\mathrm{K_2SO_4}}{n-\mathrm{KNO_3}}\,\Big|\,\mathrm{Hg}$$

has the same value in the first two of the above three solvents, but in 61·5 per cent. aqueous glycerol the coefficient is considerably greater. The change in the magnitude of the constant produced by adding alcohol or glycerol to the solution indicates a diminution in the degree of dissociation of the reacting compounds. This, taken together with the non-coincidence found between the constant in the above solvents and that calculated for KCl and $\mathrm{K_2SO_4}$ in these solvents, indicates that the degree of dissociation of these substances is less in glycerol or alcohol than in water. T. H. P.

452. *Alloys of Silver and Cadmium.* **T. Kirke Rose.** (Roy. Soc., Proc. 74. pp. 218–230, Nov. 16, 1904.)—References, in chronological order, of past experiences with trial plates of silver-copper alloys, for use in testing Imperial silver coin and silver wares, are followed by a *résumé* of attempts made by Roberts-Austen, Heycock, and Neville to produce homogeneity in plates for standard use. An examination of a number of alloys by the author, each containing 92·5 per cent. Ag, afforded evidence that the silver-cadmium alloy would prove to be the most suitable one for trial plates. Unlike the alloys containing gold, tin, or antimony, the cadmium alloy presents no difficulty in connection with the assay by ordinary methods. Ingots obtained were rolled to a gauge of 1·25 mm., and pieces cut from all parts, assayed, with the result that the plates were found to be practically of uniform composition. The cadmium does not interfere with the ordinary methods of assay, no difference in results, due to interference, being observable when the trial plates were compared with pure silver by the Gay-Lussac and Volhard processes of assay. It appears that a silver-cadmium alloy is more ductile, and is whiter than the corresponding alloy of silver and copper. The alloys containing between 40 and 50 per cent. of silver are remarkable for resisting the attack of the ordinary etching reagents, and are not affected by ammonium sulphide, under conditions in which silver-copper alloys, or pure silver, are instantly tarnished. The results of the author's investigations may be summarised as follows: (1) Evidence is afforded of the existence of the compounds $AgCd_3$, Ag_2Cd_3, $AgCd$, Ag_3Cd_2, Ag_2Cd, and Ag_4Cd. (2) The alloys containing from 0 to 25 per cent. Ag consist, when solid, of crystals of $AgCd_3$, set in a matrix of cadmium. Those containing between 25 and 40 per cent. Ag consist of the compound Ag_2Cd_3, set in a matrix consisting mainly of $AgCd_3$. The alloy containing about 50 per cent. Ag consists of crystals of a silver-rich body, set in a matrix consisting chiefly of $AgCd_3$. The matrix, or eutectic, solidifies at 420°, or nearly 300° below the freezing-point of the crystals. The alloys containing from 50 to 60 per cent. Ag consist, at temperatures above 420°, of mixtures of two different solid solutions, one of which is chiefly composed of the compound AgCd, and the other of Ag_3Cd_2. When more than 80 per cent. Ag is present, the alloys consist of a mixture of two bodies, at temperatures between the liquidus and solidus curves, but these unite to form a single solid solution at points on the solidus curve. (3) Alloys containing over 80 per cent. Ag do not undergo segregation, under ordinary conditions, and are practically homogeneous and uniform in composition, being well suited as a material for the manufacture of trial plates. The experimental data are very complete, being supplemented by cooling and equilibrium curves and micro-photographs. O. J. S.

453. *Affinity Constants of Aniline and its Derivatives.* **R. C. Farmer** and **F. J. Warth.** (Chem. Soc., Journ. 85. pp. 1713–1726, Dec., 1904.)—The authors have determined the affinity constants of aniline and a number of its derivatives by a study of the hydrolysis of their salts according to the method of Farmer [see Abstract No. 517 (1902)]. The results obtained are as follows :—

Temperature 25°. Degree of Dissociation of Water at 25° taken equal $1·09 \times 10^{-7}$.

Base.	Ratio of Distribution between Benzene and Water.	Percentage Hydrolysis of Hydrochloride at v_{32}.	$\dfrac{x^2}{(1-x)v}$ (mean)	Affinity Constants of Free Base.
Aniline	10·1	2·7	$2·25 \times 10^{-5}$	$5·3 \times 10^{-10}$
o-Toluidine	18·4	7·0	$1·62 \times 10^{-4}$	$7·3 \times 10^{-11}$
m-Toluidine	19·1	3·6	$4·10 \times 10^{-5}$	$2·9 \times 10^{-10}$
p-Toluidine	24·1	1·8	$1·05 \times 10^{-5}$	$1·13 \times 10^{-9}$
o-Nitroaniline	64·0	98·6	2·1	$5·6 \times 10^{-15}$
m-Nitroaniline	23·3	26·6	$3·01 \times 10^{-3}$	$4·0 \times 10^{-12}$
p-Nitroaniline	9·0	79·6	$9·58 \times 10^{-2}$	$1·24 \times 10^{-13}$
p-Chloroaniline	83	5·1	$8·56 \times 10^{-5}$	$1·49 \times 10^{-10}$
p-Bromoaniline	132	5·9	$1·14 \times 10^{-4}$	$1·04 \times 10^{-10}$
p-Anisidine	6·0	1·6	$8·08 \times 10^{-6}$	$1·47 \times 10^{-9}$
p-Nitrosomethylaniline	3·27	4·7	$7·29 \times 10^{-5}$	$1·63 \times 10^{-10}$
p-Nitrosodimethylaniline	51·3	4·3	$6·09 \times 10^{-5}$	$1·95 \times 10^{-10}$
o-Aminobenzoic acid	—	40·1	$8·45 \times 10^{-3}$	$1·41 \times 10^{-12}$
o-Phenylenediamine	0·549	3·3	$3·60 \times 10^{-5}$	$3·3 \times 10^{-10}$
Acetanilide	1·653	99·8	[19]	—
Aceto-*o*-toluidide	1·516	99·7	[11]	—
α-Naphthylamine	252	6·0	$1·20 \times 10^{-4}$	$9·9 \times 10^{-11}$
β-Naphthylamine	279	4·2	$5·83 \times 10^{-5}$	$2·0 \times 10^{-10}$
Aminoazobenzene	3170	18·1	$1·25 \times 10^{-3}$	$9·5 \times 10^{-12}$

[See also Abstract No. 927 (1904).] A. F.

454. *Decomposition of Ethylene Iodide under the Influence of the Iodide Ion.* **A. Slator.** (Chem. Soc., Journ. 85. pp. 1697–1708, Dec., 1904.)—Ethylene iodide in aqueous alcoholic solution decomposes quantitatively in the presence of potassium iodide, yielding ethylene and iodine. The velocity of this reaction, the author has found, is proportional to the concentration of ethylene iodide and that of the iodide ion, showing that the potassium iodide takes some direct (or catalytic) part in the reaction. The temperature quotient of the

reaction is 2·5 (for 10°). The above reaction is quite distinct from that between ethylene iodide and sodium thiosulphate, for on carrying out the two reactions in the same solution the rate of disappearance of the thiosulphate is approximately equal to that calculated from the velocity of the two single reactions. It has been shown by Burke and Donnan [see Abstract No. 2772 (1904)] that the alkyliodides turn brown on standing, and that the rate of liberation of iodine depends on the constitution. The author has found that the liberation of iodine is accelerated by the addition of iodide. Ethylene bromoiodide in presence of potassium iodide liberates iodine according to the equation $C_2H_4IBr + KI = C_2H_4 + I_2 + KBr$. The velocity of this reaction is proportional to the concentration of the bromoiodide and to that of the potassium iodide, and the temperature quotient for 10° is 2·45. Ethylene iodide is probably not an intermediate product in this reaction. The iodide decomposes about three times as fast as the bromoiodide. A. F.

455. *Alloys of Cobalt and Nickel.* **W. Guertler** and **G. Tammann.** (Zeitschr. Anorg. Chem. 42. 3. pp. 353–362, Dec. 10, 1904. Inst. für anorg. Chemie, Göttingen, Oct. 12, 1904.)—In order to determine whether separation and formation of compounds occur when molten mixtures of nickel and cobalt crystallise, the authors draw the cooling curves of the mixtures and from them derive the melting-point curves of the alloys. As in the case of nickel, so also with cobalt, a change of the magnetisable form of crystals into a non-magnetisable form, stable at higher temperatures, is observed. The influence of oxidation is small. With both metals crystallisation takes place somewhat irregularly, the supercooling amounting in some cases to 50°. The observed temperature of crystallisation is lower on the heating curve than on the cooling one, the true point of solidification lying between the two. The freezing-points for different concentrations lie on a straight line expressed by $\Delta t = 0{\cdot}35p$, where Δt is the elevation of the melting-point, and p the percentage content of cobalt. Cobalt and nickel probably separate as mixed crystals from their fused mixtures. The transition-point of the magnetisable nickel is 323°, and that of cobalt 1,150° ± 7°. If a molten mixture of cobalt and nickel crystallises without change of concentration, the transition phenomenon must be observed just as in the case of the pure metals; but if conglomerates of mixed crystals of varying composition are formed the magnetisability must gradually disappear. It is found that the transition temperature of the alloys for 10 per cent. of cobalt rises by 100°-60°. Observations of the magnetic permeability during cooling indicate that the transition of one polymorphic form of crystals into the other is completely reversible at a certain temperature. The results show that the mixed crystals separating from the fused mixture cannot contain more than 1 per cent. of cobalt more than the molten mass itself. T. H. P.

456. *Action of Sulphuretted Hydrogen on Selenous Acid; Sensitiveness of Selenium Sulphide to Light.* **A. Gutbier** and **J. Lohmann.** (Zeitschr. Anorg. Chem. 42. 3. pp. 325–328, Dec. 10, 1904. Chem. Laborat. d. Kgl. Universität, Erlangen, April, 1904.)—Sulphuretted hydrogen gives, in aqueous solutions of selenous acid, first a yellow colouration due to the formation of a dissolved, remarkably stable hydrosol, and then, after prolonged action of the gas, a canary-yellow precipitate which is extremely difficult to filter. By boiling or by the action of hydrogen ions the colloidal condition is altered, and we get a change from the yellow substance (the hydrosol) to a red plastic mass (the hydrogel). The influence of high temperature and of time in bringing about the change from the yellow form to the red has already been recognised; in the present paper the authors show that light and pressure are also able to effect the transformation of the one modification into the other. In the dark-room a piece of filter paper was dipped into a solution of selenous acid and then exposed to the action of sulphuretted hydrogen; half the filter paper was then protected from light and the other half left exposed—the half exposed to light became red, the covered part was unchanged.

D. H. J.

457. *Raschig's Theory of the Lead-Chamber Process.* **E. Divers.** (Soc. Chem. Ind., Journ. 23. pp. 1178–1181; Discussion, pp. 1181–1182, Dec. 31, 1904.)—In the ordinary equations given by Lunge to represent the reactions which take place in the manufacture of sulphuric acid by the lead-chamber process, the method by which the atmospheric oxygen goes to the sulphur dioxide is not explained. When, in the presence of air, sulphur dioxide and nitrous acid or nitrogen peroxide are brought together in water, they unite without oxidation to form compounds, which, although unstable, are not oxidisable by the air. It thus remains unexplained how the sulphur dioxide gets oxidised to sulphuric acid. According to Raschig's theory, the sulphur dioxide does *not* get oxidised by the air; there is only a condensation or union of the sulphur dioxide with the nitrous acid to form "nitrososulphonic acid" ($NO.SO_2OH$). This compound further reacts with another molecule of nitrous acid, and thus sulphuric acid is formed. Then only does aerial oxidation intervene, in order to oxidise the reduced nitrous acid. The equations are:—

$$(1)\quad 2NOOH + 2SO_2 = 2NO.SO_2OH.$$
$$(2)\quad 2NOOH + 2NO.SO_2OH = 4NO + 2HO.SO_2.OH.$$
$$(3)\quad 4NO + O_2 + 2H_2O = 4NOOH.$$

Sulphuric acid thus results in consequence of the formation of the intermediate product, nitrososulphonic acid. This acid has never been isolated, and hence the objection by Lunge to Raschig's theory. There is evidence for its existence, however; the most satisfactory, according to the opinion of the author, being the following: If highly dilute and cooled solutions of sulphur dioxide and nitrous acid are mixed in molecular proportions, both these compounds disappear, with the formation of sulphuric acid (all the sulphur of the dioxide is transformed into sulphuric acid) and a solution which decolourises permanganate. The explanation of these facts is that the interaction produces nitrososulphonic acid, which is then hydrolysed into "nitrosyl hydride" ($H.NO$) thus: (*a*) $NOOH + SO_2 = NO.SO_2OH$, and (*b*) $NO.SO_2OH + H_2O = H.NO + HO.SO_2OH$. If the solution is heated nitrous oxide is evolved ($2NO.H = N_2O + H_2O$). If the sulphur dioxide is replaced by stannous chloride much stronger solutions of nitrosyl hydride are obtained, solutions much too concentrated to be merely solutions of nitrous oxide. The presence of the nitrosyl hydride thus points to the previous formation of nitrososulphonic acid. Nitrosyl hydride slowly reacts with nitrous acid to form nitric oxide and water—

$$NO.H + NOOH = 2NO + H_2O.$$

In the presence of air dissolved in water the reaction is quick, but nitrous acid is formed instead of nitric oxide, in accordance with equation (3). When nitrous acid is dissolved in N/10 sulphuric acid instead of water, sulphur dioxide and air can be blown rapidly into the solution, the sulphur dioxide being completely transformed into sulphuric acid; there is no escape of nitric oxide and nitrogen peroxide, although the sulphuric acid is too weak to be a solvent for nitrososulphuric acid ($NO_2.SO_2.OH$). Thus the process which goes on in the manufacture can be imitated under conditions in which the existence of nitrososulphuric acid, which must be present according to Lunge's theory, is impossible. It is not necessary for the presence of nitrososulphonic acid to be demonstrated in the chambers, since its action is catalytic, and it is destroyed as quickly as it is produced. The most active regions of the chambers are considered to be those where a dense white mist is present. One part of that mist consists of liquid particles of sulphuric acid, containing between 1 and 2 molecules of water, and holding in solution all the oxides of nitrogen, one or more as the case may be. The other part is gaseous, and made up of nitrogen, oxygen, sulphur dioxide, and water vapour. The sulphur dioxide, oxygen, and water condense together on the liquid particles of the mist and form sulphuric acid under the catalytic influence of the nitrous acid present in the particles. If the oxides enter the chamber from the Glover tower in the gaseous form, and not already as the mist, they almost immediately condense with the sulphur dioxide and water to form liquid particles. According to Raschig the presence of nitrososulphuric acid is injurious, and the result of imperfect working. The rapid absorption of moist sulphur dioxide by solutions of sulphuric acid charged with nitrososulphuric acid is explained by the following equations, thus furnishing a combination of Raschig's and Lunge's theories :—

(4) $2H_2O + 2ONO.SO_2OH + 2SO_2 = 2SO_2(OH)_2 + 2NO.SO_2OH.$

(5) $2NO.SO_2OH + 2ONO.SO_2OH = 4NO + 2O(SO_2OH)_2.$ (pyrosulphuric acid).

(6) $4NO + O_2 + 2O(SO_2OH)_2 = 4ONO.SO_2OH.$

In these equations $ONO.SO_2OH$ replaces NOOH in the equations (1)–(3). In the *discussion*, **Tilden** remarked that it had yet to be shown that the various substances, and the reactions expressed in the equations given, were essential parts of the process of the production of sulphuric acid. He, himself, was quite content with a much simpler hypothesis, namely, the oxygen of the air combines directly with the nitric oxide to form nitrogen peroxide. In the latter compound there is an unsatisfied affinity, and at the same moment as the oxygen of the air combined with the nitrogen of the NO_2 another atom of oxygen was detached from the nitrogen compound by entering into union with the sulphur dioxide and water to form sulphuric acid. The **Author** replied that this theory is based on hypothetical activities, whereas that of Raschig rests on facts experimentally determined. **Oakden** mentioned that 45 per cent. of the total acid is produced in the Glover tower, where the compounds mentioned could not possibly be present in the gaseous state. It was produced in contact with the liquid nitrososulphuric acid passing down the Glover tower, altogether independently of the chambers. T. S. P.

458. *Theory of the Action of Metals on Nitric Acid.* **E. Divers.** (Soc. Chem. Ind., Journ. 23. pp. 1182–1185; Discussion, p. 1185, Dec. 31, 1904.)— The author's theory is that silver or mercury is only active upon nitric acid in the presence of nitrous acid as catalyser, and then converts it into molecular quantities of silver or mercurous nitrite and nitrate, and nothing else besides water: $2Ag + 2HNO_3 = AgNO_2 + AgNO_3 + H_2O.$ Zinc or tin acts upon nitric acid to produce zinc or stannous nitrate, and, independently of each other and without intermediate products, ammonia, nitrous oxide, and nitrogen—

$$4Zn + 8HNO_3 + NO_2.OH = 4Zn(NO_3)_2 + 8H_2O + NH_3.$$
$$4Zn + 8HNO_3 + 2NO_2.OH = 4Zn(NO_3)_2 + 5H_2O + N_2O.$$
$$5Zn + 10HNO_3 + 2NO_2.OH = 5Zn(NO_3)_2 + 6H_2O + N_2.$$

It tends also and principally to convert the nitric acid into hydroxylamine as the primary product, along with zinc or stannous nitrate. But that tendency is defeated unless a stable acid, such as sulphuric or hydrochloric acid, be present to combine with the hydroxylamine, nitric acid itself being obviously unfitted for the purpose—

$$6Zn + 7H_2SO_4 + 2NO_2.OH = 6ZnSO_4 + 4H_2O + SO_4(H_3NOH)_2.$$

The evidence in support of the theory is as follows: There are two classes of metals which act very differently on nitric acid. The first class contains silver, mercury, bismuth, and copper, and the second class tin, zinc, and all metals having a strongly basic character. *First Class.*—(1) Silver and mercury are inactive on nitric acid in the absence of nitrous acid, and active in its presence. (2) Silver and mercury are not permanently inactive upon nitric acid, as nitrous acid is formed after a time. (3) In the action of silver or mercury on nitric acid in the presence of nitrous acid, nitrate and nitrite are produced in molecular proportions, as shown by the first equation. The nitrate is a primary product. (4) Nitrous acid, nitric oxide, and nitrogen peroxide are secondary products. The nitrous acid is formed by the action of nitric acid on some of the nitrite produced in the primary reaction. Nitrogen peroxide is formed when the proportion of water is so low that the nitrous acid reacts with the nitric. Nitric oxide results when the proportion of water is so large that the nitric acid fails to prevent the nitrous acid decomposing according to the equation $3HNO_2 = HNO_3 + 2NO + H_2O$. *Second Class.*—(5) When zinc acts on nitric acid, not nitrate and nitrite or nitrous acid are primary products, but nitrate and either hydroxylamine, ammonia, nitrous oxide, or nitrogen, or all these together, but independently, and each associated only with the nitrate. The presence of nitrous acid is sufficiently accounted for by the action of zinc on the zinc nitrate. (6) The production of hydroxylamine when a second acid is present is explained by the combination of the acid with the hydroxylamine to form a salt, which is stable in the presence of zinc and acid; all the nitric acid is thus left as such to be presented to the zinc for reduction. (7) Ammonia and nitrous oxide are partly primary products, since they are freely produced from the first, by action of zinc on nitric acid, and partly secondary. Hydroxylamine salts, in the absence of much free acid, are reduced by zinc to ammonia; so is zinc nitrite. Nitrogen peroxide and nitric oxide are undoubtedly secondary products derived from the decomposition of nitrous acid by nitric acid and by water respectively. Nitrous oxide may result from the interaction of hydroxylamine and nitrous acid; nitrogen from ammonia and nitrous acid. (8) Hyponitrous acid is never found as a product of the action of zinc or tin on nitric acid. The above conclusions are supported by the work of Rây on mercurous nitrite. T. S. P.

459. *Electrolytic Reduction of Carboxylic Acids and their Esters in Sulphuric Acid Solution.* **J. Tafel** and **G. Friedrichs.** (Ber. Deut. Chem. Gesell. 37

pp. 3187–3191, Sept. 24, 1904.)—In sulphuric acid solution oxalic acid is electrolytically reduced almost quantitatively to glyoxylic acid. Other dicarboxylic acids, such as malonic, succinic, and tartaric, and also most monocarboxylic acids, are unchanged. The esters of oxalic, malonic, aceto-acetic, benzoic, and phthalic acids are, however, readily reduced electrolytically. Thus ethyl and methyl benzoates yield benzyl ethyl ether and benzyl methyl ether respectively, but with ethyl oxalacetate and ethyl benzoylacetate, apparently only the keto-group is attacked, as only 2 atoms of hydrogen are used up. In some cases the solvent employed has an influence on the reaction; thus, in aqueous solution, ethyl oxalate uses up 4 atoms of hydrogen, but in alcoholic solution only 2 atoms. T. H. P.

460. *Theory of Separation of Metals from vigorously stirred Electrolytes.* **R. Amberg.** (Zeitschr. Elektrochem. 10. pp. 853–855, Nov. 4, 1904.)—Brunner divides the process into three parts: (1) Diffusion of the metal to the boundary. (2) Discharge of the metallic ion. (3) Change from the liquid to the solid state. In electrochemical analysis when the current used is large, diffusion may be the dominant factor in determining the rate at which metal is deposited, an increase of voltage producing little increase in the current. The following table shows in the case of palladium the difference between the time T_2 theoretically required for the deposition of a weight g of metal on a kathode revolving at n r.p.m. and the time T_1 actually required. The excess $T_1 - T_2$ decreases steadily as the speed n increases.

Maximum Current = 0·25 amp.

	g	T_1	T_2	$T_1 - T_2$	n
1	0·77	5·50	1·55	3·95	500
2	0·6	4·45	1·20	3·25	620
3	0·95	4·5	1·91	2·49	800
4	2·3	6	4·62	1·38	1,000

T. M. L.

461. *Electrolysis of Cyanides.* **A. Brochet** and **J. Petit.** (Bull. Soc. Chim. 21. 12. pp. 744–748, June 20, 1904. Chem. News, 90. p. 321, Dec. 30, 1904.)—According to statements in the text-books, iron dissolves in potassium cyanide solution, but the action is a very inconsiderable one. Thus, when iron in the form of strips, nails, wire, &c., is placed in a hot or cold solution of 4 gm.-mols. of potassium cyanide per litre, an extremely small quantity of hydrogen is evolved, and after a certain time traces of potassium ferrocyanide can be detected. If the iron is placed in contact with a strip of platinum, the evolution of gas becomes a little more evident. The reaction is not much more distinct with pyrophoric iron. It has been stated by Gore that, in the electrolysis of potassium cyanide solution with iron electrodes, the latter dissolve when the current is strong but remain unattacked if the current is weak. The authors find, however, that the amount of solution taking place is absolutely insignificant. Thus, with an iron wire of 8 sq. cm. surface, and using a current density of 50 amps. per sq. dm., the loss in weight of the iron is about 0·001 gm. per amp.-hour. With a diaphragm the attack on the metal is somewhat greater; thus, with 12 amps. per sq. dm., the loss in weight is

0·005 gm. per amp.-hour, and with 30 amps. per sq. dm., 0·030 gm. per amp.-hour. The electrolysis of potassium ferrocyanide with platinum electrodes gives ferricyanide at the anode, whilst, with ferricyanide solutions, ferrocyanide is obtained at the kathode, with formation of a blue deposit at the anode. With electrodes of iron, this metal takes part in the reaction, and in both cases gives a variety of Prussian blue at the anode, but only if a diaphragm is used ; otherwise, the alkali formed at the kathode decomposes this blue deposit, giving ferric hydroxide. Without a diaphragm, a state of variable equilibrium is arrived at according to the conditions of the experiment. The same takes place with an alternating current, but in this case it is necessary to use an extremely high current-density. [See also Abstract No. 282 (1905).] T. H. P

462. *Electrolytic Preparation of Titanous Sulphate.* **W. H. Evans.** (Manchester Lit. and Phil. Soc., Mem. 49. 2. pp. 1–3, Jan. 16, 1905. Chem. News, 90. pp. 313–314, Dec. 23, 1904.)—The experiments here described on the electrolytic reduction of titanium sulphate were made without a diaphragm, while the kathode solution was well stirred either by a mechanical stirrer or by passing a current of an inert gas through the liquid. The results are briefly as follows : The yield of titanous sulphate falls rapidly as the current density is increased, but increases considerably as the temperature rises. Thus, using a current density of 4·5 amps. per 100 sq. cm., the yield at 70° can be kept above 70 per cent. until quite half of the titanium has been reduced, while at 0° the yield is only about 45 per cent. of the theoretical amount ; the difference in the two cases is clearly seen in the fact that there was no visible evolution of hydrogen at the kathode in the hot solution, whereas in the cold a considerable amount of hydrogen is given off. The yield increases greatly with increase of concentration of the titanium sulphate solution employed. No great difference in yield is observed on substituting the lead electrodes by platinum ones, but there is a slight diminution when the latter are used.

T. H. P.

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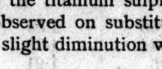
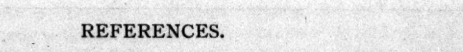
463. *Plumbic Salts.* **K. Elbs** and **R. Nübling.** (Zeitschr. Elektrochem. 9. pp. 776–782, Sept. 17, 1903. Phys. Chem. Univ. Lab., Giessen, July, 1903.)—A description is given of the method of preparing plumbic chloride by electrolysis. T. M. L.

464. *Magnesium Ethyl Iodide as Condensing Agent.* **A. Franke** and **M. Kohn.** (Akad. Wiss. Wien, Sitz. Ber. 113. 2b. pp. 479–484, June, 1904. From the Chemisches Laborat. Ad. Lieben's an der k.k. Universität zu Wien.)—The authors find that by the action of magnesium ethyl iodide on formisobutyraldol—



$$(\mathrm{CH_3})_2 . \mathrm{C}\begin{array}{l}\diagup \mathrm{CH_2OH} \\ \diagdown \mathrm{CHO}\end{array}$$

there is formed the condensation product—



$$(\mathrm{CH_3})_2 . \mathrm{C}\begin{array}{l}\diagup \mathrm{CH_2OH} \\ \diagdown \mathrm{CH_2 . O . CO .} \overset{\overset{\mathrm{CH_2OH}}{|}}{\mathrm{C}} - (\mathrm{CH_3})_2\end{array}$$

instead of the expected glycol. D. H. J.

465. *Preparation of Calcium.* **Rathenau.** (Zeitschr. Elektrochem. 10. pp. 508–509 ; Discussion, p. 509, July 22, 1904. Paper read before the 11 Hauptversamml. d. Deutsch. Bunsen Gesell., May 12–14, at Bonn.)—A method is described in outline by which calcium can be prepared in considerable quantities from fluor-spar. Poulenc, of Paris, has prepared an alloy of aluminium and calcium, which it is proposed to use to absorb the bubbles of carbon monoxide, oxygen, and nitrogen which are found in cast steel ; the aluminium reduces the monoxide to carbon and oxygen, and it is believed that the calcium would absorb both the oxygen and the nitrogen. **Muthmann,** of Munich, states that he has prepared calcium from a mixture of $\frac{2}{3}$ of chloride and $\frac{1}{3}$ of fluoride of calcium, with a current of 80 amps. at 15 to 20 volts ; 600 gm. of pure white metal were produced in 4 hours. T. M. L.

466. *Oxides of Platinum.* **L. Wöhler.** (Zeitschr. Anorg. Chem. 40. 3. pp. 423–464, July 30, 1904. Chem. Laborat. d. techn. Hochschule, Karlsruhe.)—Pure platinic oxide was prepared by boiling platinic chloride with soda and neutralising with acetic acid. The product is almost colourless, and has the formula PtO_2, $4H_2O$. When dried in the air or, for a short time, over calcium chloride it is converted into the trihydrate, but yields the dihydrate when kept in a vacuum desiccator over sulphuric acid, or when heated for a short time at 100°. The dioxide decomposes above 300° in an atmosphere of carbon dioxide, the monoxide above 400° C. Prost's oxides PtO_2, $3H_2O_1$, Pt_3O_4, $9H_2O$, and Pt_5O_{11}, $11H_2O$ were found to be mixtures of the dioxide with basic nitrate, and the supposed tetroxide Pt_3O_4 and sesquioxide Pt_2O_3 were shown to be mixtures of dioxide and monoxide. T. M. L.

467. *Ratio of Radium to Uranium in some Minerals.* **B. B. Boltwood.** (Amer. Journ. Sci. 18. pp. 97–103, Aug., 1904.)—A fuller description of experiments already recorded [see Abstract No. 1823 (1904).] T. M. L.

468. *Doubly Linked Carbon-Nitrogen System,* $>C:N\cdot$. **L. Henry.** (Bull. Acad. Roy. Belg. 6. pp. 741–754, Aug. 1, 1904.)—Compounds containing the grouping $.CH:N.$ are able to form additive derivatives with both sodium hydrogen sulphite and hydrogen cyanide. Thus, with concentrated sodium hydrogen sulphite solution, crystalline insoluble or slightly soluble products of the type $.CH(SO_3Na).NH.$ are formed, and these react further with acids or bases in the same way as the similar compounds prepared from aldehydes or ketones. A number of examples of such additive compounds are given. T. H. P.

469. *Exact Estimation of Atmospheric Carbon Dioxide.* **A. G. Woodman.** (Technology Quarterly, 17. pp. 258–269, Sept., 1904. Contribution from the Laboratory of Sanitary Chemistry.)—A critical review of the methods which have been employed for the determination of atmospheric carbon dioxide. It is concluded that the average amount of carbon dioxide in fresh air is approximately 3 parts in 10,000, from which, however, there is a constant variation due to local and general causes. W. H. Si.

470. *Rendering Active of Oxygen. X. Autoxidation of Cerous Salts.* **C. Engler.** (Ber. Deut. Chem. Gesell. 37. pp. 3268–3273, Sept. 24, 1904.)—The large absorption of gas by cerous salts is due to the presence of carbon dioxide in the oxygen employed. This carbon dioxide is formed when the carbonate solution is treated with acid to form the acid carbonate and may be introduced into the absorbing vessel. The amount of peroxide formed invariably agrees with the ratio of 1 mol. of oxygen to 2 atoms of cerium, and this is confirmed by the absorption when care is taken to remove all the carbon dioxide from the oxygen. [See also Abstract No. 2393 (1904).] T. H. P.

471. *Rendering Active of Oxygen.* XI. *Autoxidation of Thiophenol.* **C. Engler** and **H. Broniatowski.** (Ber. Deut. Chem. Gesell. 37. pp. 3274–3276, Sept. 24, 1904.)—In the autoxidation of thiophenol in potassium carbonate or dilute ammonia, the absorption of oxygen is slow and is only complete after about seven days. One molecule of oxygen is absorbed for every four of thiophenol, and the reaction probably takes place in the two stages: $2C_6H_5.SH + O_2 = (C_6H_5)_2S_2 + H_2O_2$ and $2C_6H_5.SH + H_2O_2 = (C_6H_5)_2S_2 + 2H_2O$. T. H. P.

472. *Present Problems of Organic Chemistry.* **W. A. Noyes.** (Science, 20. pp. 490–501, Oct. 14, 1904. Paper read at the International Congress of Arts and Sciences, St. Louis, Sept. 21, 1904.)—The author traces in brief outline the steps which have led up to our present theories of structure and valency. He discusses also van't Hoff and Le Bel's hypothesis, double linkings, the theory of electrons, &c. The paper does not admit of concise abstraction. T. H. P.

473. *Oxidation of Methyl and Ethyl Alcohols at their Boiling-points.* **R. Duchemin** and **J. Dourlen.** (Comptes Rendus, 139. pp. 679–681, Oct. 31, 1904.)—Distillation of methyl and ethyl alcohols with beads of copper, brass, tin, or zinc develops formic and acetic acids respectively, the amount increasing with duration of distillation, copper giving the largest quantity in both cases. Distillation from a glass flask without contact with any metal also produces a distinct acidity. The action of metals may be explained by Berthelot's hypothesis, which assumes the dehydrogenation of the alcohol, forming a metallic hydride, and an aldehyde, which is then oxidised to an acid by the oxygen dissolved in the alcohol. Samples of alcohol which show no acid reaction with litmus paper in some cases are found to contain quantities of acid readily estimated, before or after addition of water, by titration with soda, using phenolphthalein as indicator. W. H. Si.

474. *Atomic Weight of Aluminium.* **Kohn-Abrest.** (Comptes Rendus, 139. pp. 669–671, Oct. 31, 1904.)—The hydrogen evolved by the action of hydrochloric acid on 0·5–0·7 gm. aluminium, the impurities of which were known, was, after drying, passed over red-hot copper oxide, and the water thus formed collected and weighed, whence the ratio of aluminium to water, and thus to hydrogen, has been calculated. The result obtained as a mean of seven experiments, taking $H=1$, is 27·05, while by determining the amount of aluminium oxide produced from a known weight of aluminium, the value 27·09 is deduced. W. H. Si.

475. *Physico-chemical Studies of Tin.* **E. Cohen** and **E. Goldschmidt.** (Zeitschr. Phys. Chem. 50. pp. 225–237, Dec. 16, 1904. Van't Hoff Laboratorium, Utrecht, June, 1904.)—Besides grey and white tin, mention is made in the literature of rhombic, tetragonal, and previously-molten tin. Ordinary tin is found to have a density of 7·287 at 15°. Electrolytic tin encloses amounts of the solution varying with the current density employed in its preparation. No difference exists between electrolytic tin and tin melted under normal conditions, both forming tetragonal crystals. The behaviour of tin may be represented by the following scheme:—

$$\text{Grey} \overset{20^\circ}{\rightleftarrows} \text{tetragonal} \overset{170^\circ}{\rightleftarrows} \text{rhombic} \overset{232^\circ}{\rightleftarrows} \text{molten.}$$

Both the rhombic, and especially the tetragonal, forms have a considerable interval of metastable existence. [See also Abstract No. 529 (1901).] T. H. P.

476. *Stereoisomeric Glucoses and the Hydrolysis of Glucosidic Acetates.* **E. F. Armstrong** and **P. S. Arup.** (Chem. Soc., Journ. 85. pp. 1043–1049, July, 1904.)—α- and β-glucose pentacetates are hydrolysed at the same rate by alkalies in dilute alcoholic solutions, whilst β-galactose pentacetate is hydrolysed considerably faster. The tetracetates of α- and β-methylglucosides and α- and β-methylgalactosides are hydrolysed at practically the same rate. T. M. L.

477. *Borax and Carbonic Acid.* **L. Grünhut.** (Zeitschr. Phys. Chem. 48. pp. 569–576, July 1, 1904.)—In dilute aqueous solution borax is completely decomposed into sodium metaborate and free boric acid—

$$Na_2B_4O_7 + 3H_2O = 2NaBO_2 + 2H_3BO_3.$$

If carbon dioxide is led into the cold solution the acid is liberated also from the metaborate, and sodium bicarbonate is produced; but if an excess of boric acid is added, reversal takes place and the metaborate is reproduced—

$$H_2O + NaBO_2 + H_2CO_3 \rightleftarrows H_3BO_3 + NaHCO_3.$$

In mineral waters which contain carbon dioxide the small quantities of boric acid present must be in the free state. T. M. L.

478. *Physico-chemical Investigations in the Amide Group.* **C. E. Fawsitt.** (Zeitschr. Phys. Chem. 48. pp. 585–592, July 1, 1904. Edinburgh Univ., Dec., 1903.)—The amides possess no acid character, and are better represented by the formula $R.CO.NH_2$ than by the "enolic" formula $R.C(OH):NH$. The absence of electrical conductivity is a good test of the purity of the amide. The viscosity of aqueous solutions of acetamide and of carbamide is expressed by the formula $\eta_x = A^x$, where η_x is viscosity at concentration x, and A is a constant. The viscosity of mixtures of carbamide with potassium chloride and with hydrogen chloride obeys an additive law. T. M. L.

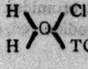
479. *Theory of Colloids.* **E. Jordis.** (Zeitschr. Elektrochem. 10. pp. 509–515; Discussion, pp. 515–518, July 22, 1904. Paper read before the 11 Hauptversamml. d. Deutsch. Bunsen Gesell., May 12–14, at Bonn.)—A theoretical paper, followed by a long discussion, but not suitable for abstracting. T. M. L.

480. *Action of Eosin Solution on Oxidisable Substances.* **W. Straub.** (Arch. für exp. Path. und Pharm. 51. pp. 383–390, July 28, 1904.)—Under the action of light and in presence of eosin and oxygen, potassium iodide solution deposits iodine; in the dark the reaction also takes place, but only very slowly. With concentrated solutions of the iodide, the amount of iodine liberated is proportional to the amount of eosin and to the time. With very dilute solutions of a constant amount of eosin, the amount of iodine set free in a certain time increases with the dilution. This is owing to the fact that, in dilute solutions, the active rays, which exhibit green fluorescence, are able to penetrate the whole liquid, whilst in stronger solutions they undergo absorption at the surface. The complete decolourisation of eosin (1 mol.) requires 65 mols. of oxygen. The reaction probably depends on the formation of eosin peroxide. T. H. P.

481. *Constitution of Hydrous Thallic Chloride.* **F. M. McClenahan.** (Amer. Journ. Sci. 18. pp. 104–112, Aug., 1904. Contributions from the Kent Chemical Laboratory of Yale University, No. 119. Zeitschr. Anorg. Chem. 42. 1. pp. 100–109, Nov. 7, 1904.)—The water in hydrous thallic chloride $TlCl_3.4H_2O$, appears to be held in the complex in three different ways, as expressed by the symbol—

$$TlCl_3.H_2O.H_2O.2H_2O.$$

The fourth molecule of water is less easily removed in an atmosphere of hydrogen chloride than in air. Graphic formulæ, in which the tetravalency of oxygen is assumed, are used to express the possible constitution of the different hydrates. The monohydrate is represented as



$$\begin{matrix} H \\ H \end{matrix} > O < \begin{matrix} Cl \\ TCl_2. \end{matrix}$$

T. M L,

482. *The Hydrolytic Enzyme Contained in Castor-oil Seeds.* **W. H. Walker** and **L. M. Bourne.** (Technology Quarterly, 17. pp. 284–288, Sept., 1904.)—The utilisation of the enzyme contained in castor-oil seeds has been proposed by Connstein, Hoyer, and Wartenberg, and the authors took up the study of this process with a view of ascertaining its industrial applicability. The press-cake, obtained after the oil has been extracted from the seeds, was found to be ineffective. In further experiments the oil was extracted by various solvents, and in this way active residues were obtained. It was not found possible, however, to obtain a satisfactory solution of the enzyme. Even washing with water was sufficient to decrease the enzymic power 50–60 per cent. The process of germination appears to diminish the hydrolytic principle. The chief difficulty in applying the method to the commercial preparation appears to be the preparation of a perfect emulsion. A. F.

483. *Nature of Liquid Crystals.* **G. Bredig** and **G. v. Schukowsky.** (Ber. Deut. Chem. Gesell. 37. pp. 3419–3425, Sept. 24, 1904.)—When an electric current with a voltage varying from 72 to 20,000 is passed through a suspension of shellac in water, the particles of shellac immediately gather at the anode, and in 5 minutes the separation can be distinctly seen. Under the microscope the deposition can be observed almost instantaneously when an e.m.f. of 70 volts is employed. With the so-called liquid crystals of *p*-azoxyanisole, anisaldazine, the condensation product of benzaldehyde, benzidine or cholesterol propionate, no such separation takes place.
T. H. P.

484. *Action of Arsenious Acid on Freshly-precipitated Ferric Hydroxide.* **W. Biltz.** (Ber. Deut. Chem. Gesell. 37. pp. 3138–3150, Sept. 24, 1904.)—Freshly-precipitated ferric hydroxide does not form a basic ferric arsenite nor a solid solution with arsenious acid, which it takes up by adsorption. It is to this that the hydroxide owes its action as an antidote in arsenical poisoning. Silicic acid and aluminium hydroxide exhibit very slight adsorptive properties. T. H. P.

485. *Lability of Enzymes.* **K. Asō.** (Coll. of Agric. Tokyo, Bull. 6. pp. 57–75, 1904.)—In very dilute solutions, enzymes are not destroyed by small amounts of cyanogen. Very dilute nitrous acid has a greater injurious effect on enzymes than equally dilute nitric acid. Dilute neutral solutions of hydrazine, methylhydrazine, and hydroxylamine destroy the activity of enzymes ; this is best explained by supposing that the active groups in enzymes are either aldehydic or ketonic. T. H. P.

486. *Action of Hydrogen Peroxide on Enzymes.* **A. J. J. Vandevelde.** (Beitr. chem. Physiol. Path. 5. pp. 558–570, 1904.)—Hydrogen peroxide favours the enzymic functions of rennet, pepsin, trypsin, and the proteolytic enzyme of milk. On diastase and catalase, however, it exerts an inhibiting action. T. H. P.

487. *Ionisation of Chromophores.* **H. Decker.** (Ber. Deut. Chem. Gesell. 37. pp. 2938–2941, Sept. 24, 1904.)—Certain ammonium, oxonium, and thionium iodides (and bromides), which are coloured in the solid condition, give colourless solutions with a large quantity of water, so that they yield colourless ions. The degree of dissociation may be followed colorimetrically in some cases. Non-ionising solvents, such as alcohol and chloroform, yield coloured solutions even when very dilute. In those cases where the ion is already coloured (*e.g.*, the methylacridinium ion), and where, therefore, the chlorides, nitrates, &c., are also coloured both in the solid and dissolved state, the influence of the chromophoric group is seen in the deepening of the colour of the solid iodides and bromides. Thus, the bromide of methylacridinium is orange-coloured and the iodide red, but in dilute solutions they exhibit only the yellow colour of the ions. T. H. P.

488. *Theory of Saponification.* **R. Fanto.** (Monatshefte für Chemie, 25. pp. 919–928, Sept. 17, 1904.)—The author is unable to find a solvent which will allow of the hydrolysis of triglycerides in a homogeneous solution and will not take part in the reaction. In a number of experiments on the hydrolysis of triglycerides under conditions favourable to the formation of di- or mono-glycerides no trace of these could be found, so that if they are formed they must undergo immediate further hydrolysis. The saponification of triglycerides by potassium hydroxide is practically a quadrimolecular reaction. T. H. P.

489. *Resemblance between Iron Salts of Organic Acids and Salts of Nitro-derivatives.* **M. I. Konowalow.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 36. pp. 1062–1067, 1904.)—All the monobasic organic acids give ferric salts which dissolve in ether with formation of a red colouration similar to that given by primary and secondary nitro-derivatives. The sensitiveness of the reaction is less with the organic acids than with the nitro-compounds; in applying the test to the latter substances, it is necessary to get rid of any free acid by means of soda. The ferric salts of the organic acids are formed to a slight extent by the action of ferric chloride, hydroxide, or basic carbonate on the free acid in aqueous solution. They are formed more readily by the interaction of the free organic acid and iron reduced by hydrogen, and still more readily by the action of ferric chloride on the free acid in aqueous alcoholic solution. T. H. P.

490. *Solubility in Mixtures of Water and Acetone.* **W. Herz** and **M. Knoch.** (Deutsch. Phys. Gesell., Verh. 6. 19. pp. 221–223, Oct. 15, 1904. Chem. Inst. der Univ., Breslau, Aug. 9, 1904.)—The solubility was determined of potassium permanganate and chloride, boric and succinic acids, and barium hydroxide in mixtures of water and acetone. Potassium chloride and barium hydroxide showed a continuous decrease of solubility as the proportion of acetone was increased, but the other substances exhibited a maximum solubility in mixtures of acetone and water, the value in acetone alone being less than that in water alone. T. M. L.

491. *Equilibrium in the System BeO, SO_3, H_2O.* **C. L. Parsons.** (Zeitschr. Anorg. Chem. 42. 2. pp. 250–264, Nov. 21, 1904. New Hampshire College, Durham, N.H. Translation.)—Tetrahydrated beryllium sulphate, $BeSO_4, 4H_2O$, has a vapour pressure of 20 mm. of olive oil at 20° and is only stable in moist air. At 100° it yields the dihydrate, which is stable at ordinary temperatures. The author is unable to prepare other hydrates, although a hepta-hydrate has been described. Compounds of x BeO : SO_3 react acid towards litmus and are capable of taking up further relatively large quantities of the oxide. It is found that the so-called basic beryllium sulphates do not exist as separate chemical compounds, but are solid solutions of the sulphate in the hydroxide; they are much more basic when in equilibrium with the mother liquor than when freshly precipitated. T. H. P.

492. *Electric Transport of Microscopic Particles.* **A. Cotton** and **H. Mouton.** (Comptes Rendus, 138. pp. 1584–1586, June 20, and pp. 1692–1694, June 27, 1904.)—The authors worked with a colloidal solution of silver, as prepared by Bredig. Current is passed through a layer of this solution by means of electrodes of thin sheet platinum. A microscopic examination midway between the electrodes shows that the particles in the body of the solution move towards the anode, but in the lower and upper layers the motion is the reverse. The thickness of these lower layers is about 25 μ. If the thickness of the whole is sufficiently reduced the upper and lower layers coincide and there is only one movement. The movement varies with the thickness of the layer of solution and the material in contact with it. The particles move at the rate of 2 μ to 4 μ per sec., and readily enough to show the effect of an alternating current. Some liquids show movements in the reverse direction. The authors ascribe the movements partly to the particles themselves and partly to the liquid. W. R. C.

493. *Passivity of Metals.* **W. J. Müller.** (Zeitschr. Phys. Chem. 48. pp. 577–584, July 1, 1904. From Ber. der Naturforsch. Gesell., Freiburg, 14. pp. 190–198, 1904.)—The passivity of metals has been explained (1) by the formation of a superficial layer of oxide or gas, (2) by a modification in the character of the metallic surface. The latter explanation is regarded by the author as correct on the ground that the dissolution of a metal demands the acquisition of a positive charge; in the passive state the metal is made to function as an anode, and so can only acquire a negative charge. This theory explains the fact that when chromium is brought into contact with chromic acid it dissolves exclusively as chromic acid, *i.e.*, as a negatively charged anion, and not as a chromium salt in which it would function as a positively charged kathion. T. M. L.

494. *Catalytic Phenomena in the Preparation of Persulphuric Acid.* **G. I. Petrenko.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 36. pp. 1081–1088, 1904.)—The yield of persulphuric acid obtained by the electrolysis of sulphuric acid is dependent on the use of a platinum anode which apparently oxidises and then exerts a catalytic action, diminishing the yield of the peracid. The yield of the latter is almost doubled by the addition of hydrochloric acid. With an iridium anode, the yield is considerably less than with platinum, and the iridium goes into solution more readily than platinum. T. H. P.

495. *Behaviour of Insoluble Electrodes especially in the Electrolysis of Hydrochloric Acid.* **R. Luther** and **F. J. Brislee.** (Zeitschr. Phys. Chem. 45. pp. 216–234, Sept. 22, 1903. Phys.-chem. Institut, Leipzig, July, 1903.)—I. Curves are given showing the relation between electrode-potential and current in the case of hydrochloric acid of different strengths in contact with an anode of platinum or iridium. The condition of the anode was found to be of importance in determining the form of the curves, and at least three distinct states of the platinum anode could be recognised. **E. Bose.** (Ibid. 49. pp. 227–228, Aug. 9, 1904.)—In a brief note attention is called to the earlier work of the author, and especially to the fact that similar observations have been recorded in the case of bromine. T. M. L.

496. *Formation of Nitrites and Nitrates by Electrolytic Oxidation of Ammonia in Presence of Copper Hydroxide.* **W. Traube** and **A. Biltz.** (Ber. Deut. Chem. Gesell. 37. pp. 3130–3138, Sept. 24, 1904.)—When aqueous sodium hydroxide containing ammonia is electrolysed, practically no nitrite is formed at the anode; but when copper hydroxide is added, nearly the whole of the oxygen evolved at the anode is used up in converting the ammonia present into ammonium nitrite. The electrodes used by the author were of platinum or iron, the current strength varying from 5 to 15 amps. As the electrolysis goes on, the amount of nitrite formed increases at first, but decreases later on, owing to its oxidation to nitrate; this latter oxidation process ultimately becomes complete. T. H. P.

497. *Diffusion of One Electrolyte in Presence of Another with a Common Ion.* **U. Grassi.** (Gazzetta Chim. Ital. 34. 2. pp. 229–232, Oct., 1904.)—The problem of the diffusion of an electrolyte, KA, in presence of another, K′A, has been worked out theoretically and tested by Abegg and Bose [see Abstract No. 687 (1900)]. The authors derive formulæ for the case where the dissociation is taken into account. These show that in presence of one of its salts, an acid has a somewhat greater coefficient of diffusion than in the pure solvent. T. H. P.

498. *Electrolytic Separations with Rotating Anode.* **D. S. Ashbrook.** (Amer. Chem. Soc., Journ. 26. pp. 1283–1290, Oct., 1904.)—Practical details are given as to the electrolytic separation of copper from the following metals: Al, Sb, Cr, Cd, Co, Fe, Pb, Mg, Mn, Ni, Ur, Zn; of cadmium from Al, Cr, Co, Fe, Mg, Mn, Ni, Zn; of silver from Al. For these the original must be consulted. L. H. W.